The effect of a music intervention on the temporal organisation of reading skills

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Submitted for

PhD degree examination

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Word count (exclusive of lists of appendices and lists of reference): 79,759

Abstract

This study investigated the reading behaviour of school children following participation in a rhythm-based music intervention. The investigation was inspired by pupils' progress in music lessons after using the rhythm-based music intervention. Little empirical work has been done on metre and learning. This project has focused upon 'temporal regulation' and 'temporal integration' as a possible learning pathway linking the music intervention, as an entrainment activity to reading behaviour. The theoretical framework draws upon multi-disciplinary areas of literature to converge on metre as an organisational feature common to music and language.

The methodology of this small scale research project involved three stages. First, three empirical explorations of the music intervention used a mixed experimental design. The randomly selected participants were school children, 8-10 years of age. Secondly, a small, randomly selected sample of school children with below average capability in reading comprehension or reading fluency, took part in a two-treatment experimental design comparing the music intervention and a phonics intervention. The third stage, a trial in two schools, investigated whether the effects of the rhythm-based music intervention were sustained when the music intervention was directed by school staff.

Although only small samples were involved, a consistent effect was found in gains in reading comprehension for below average capability readers, following participation in the music intervention. In the two-treatment design, positive effects were found for rate of reading, reading comprehension and phonological discrimination but not for reading accuracy. In the trial in two schools, effects were found for reading comprehension, reading accuracy in both schools and rate of reading in one school suggesting that the music intervention may be suitable for use as part of the music or the literacy programme in schools. Overall the data suggested that the rhythm-based music intervention had a positive effect on children's reading behaviour. (298 words)

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Acknowledgments

I am especially grateful to my first supervisor Professor Susan Hallam for accepting me as one of her research students and for her clarity, rigour and expertise with which she has patiently guided me during this research project. I also am very grateful to my second supervisor Professor Graham Welch for his insightful comments and suggestions, and to Professor Keith Swanwick, for directing me towards the 'Hierarchy of Knowledge Acquisition' model. The meticulous work of data auditor, Joy Castell-Evans, the technological advice and support of Ross Purves, and the helpful suggestions made by Professor Jane Hurry are also very warmly acknowledged.

I would like to thank the Music Services of Bedfordshire and Hertfordshire for the part they have played in initially contacting schools on my behalf at the beginning of the investigation. Indeed I am very grateful to all the schools that agreed to participate. The support of all the headteachers, the patience of all the classroom teachers and the overall cooperation of the pupils is warmly acknowledged. I would particularly like to thank the school staff that conducted the music intervention in the school trials. Their energy, good humour and commitment is very much appreciated.

I am very grateful to the Bedford Charity (The Harpur Trust) for their support and encouragement, and for helping to fund this project through their Post-graduate Awards. I am also grateful to the Bernarr Rainbow Trust for their Award for Music Teachers which has contributed to the costs of this investigation.

The music resource 'Stepping Stones' used in the music intervention is reproduced by kind permission of the publishers, Boosey & Hawkes, London. The practical examination criteria of The Associated Board of The Royal Schools of Music is set out in Appendix VII. Their permission is gratefully acknowledged here both for reproduction of the criteria and for its part in the development of the 'Analysis of Reading Fluency'.

Rationale

Chapter one

Part One

1.1.1 Developing the strategy

Many years ago, while employed by a Local Education Authority Music Service as an instrumental music teacher, I was presented with a group of mischievous nine year olds who were apparently very keen to learn to play the cello. I felt somewhat uneasy; their classroom teacher had described several of the group to me as 'poor…..very poor'. She was not referring to their socio-economic status but to their ability, and their attitude towards their schoolwork. I doubted whether I possessed sufficient teaching experience and pedagogic skills to teach low ability pupils with success. If I had not felt this way, there would have been no reason for me to hesitate to teach them, as I have always firmly believed in the provision of access to instrumental music education for all. Nevertheless, I felt apprehensive about embarking on a course of cello lessons with a group of young pupils that would need special teaching skills to prevent this becoming another experience of learning failure for them.

This group of pupils showed great excitement and enthusiasm for music lessons and for the cello in particular. I hoped that such motivation might provide enough momentum to somehow compensate for the pedagogical turbulence that lay ahead. Although I would normally begin by introducing pupils to the instrument, in this instance I decided to assess the pupils' aural acuity and perception. It transpired that each one of these pupils was very weak in each and every test that I gave them. I had hoped that I might have found an area of relative strength through which to approach instrumental music lessons. Unfortunately, this idea, in which the musical 'resource' is first and foremost 'within' the pupil, was not going to apply in these circumstances. The alternative approach was to structure the lessons so that the instrument became the musical 'resource' with which the pupils engaged, and from which they ultimately learned to 'internalise' the music.

The group were very excited as I removed the cellos from the cello covers. As I tuned the instruments and correctly positioned each pupil with their own cello, my explanations to individual pupils were punctuated by a background of chatter about their playtimes, about their games of football, about music they made on electronic keyboards. I realised that these instrumental music lessons were perhaps about to become an extension of this private recreational world in which these pupils were the stars: confident footballers and accomplished maestros of the electronic keyboard.

I introduced the group to the cello and tried to teach them the names of the four open strings 'C', 'G', 'D', 'A' using a variety of mnemonics that I usually found to be very helpful and I expected the group to enjoy this light-hearted approach to learning the open string letter names. I was wrong. This simple task had been too difficult and signs of frustration, betrayal and disappointment flooded towards me from the group. Slightly alarmed, I knew that 10 minutes of the lesson remained and that I needed to try to keep the group amused and to achieve something concrete within that time span. I also realised that I was out of my depth; I had no understanding or experience of teaching pupils of this ability level. I decided to abandon my usual initial cello lesson routines and opted to target the pupils' own interests. Football....something involving controlled footwork, combined with the electronic keyboard, sprang to mind as the obvious solution and I quickly invented a stamping game for the group, while I played the electronic keyboard. The spirits of the group soared. I was rewarded with heartfelt approval from the group: 'Oh Miss!....This is wicked!' they exclaimed. With interest I noticed that though their stamping was quite chaotic and non metrical to begin with, each pupil focused on improving their coordination and timing without me explaining that this was necessary. I encouraged the group to chant the open string mnemonics as a 'rap'. Within the ten-minute span of the remainder of the lesson, this task had been accomplished. The pupils left the lesson in high spirits, I felt relieved that the lesson was over but also felt that I had discovered a strategy with which to teach this group for the time being.

The subsequent lessons were organised so that each began with a period of review in which all the work covered thus far was discussed and the pupils were encouraged to demonstrate each skill they had learned to the rest of the group. As I introduced each new element of cello playing to the group, I used the stamping game as a teaching strategy. After a few weeks it became clear that the group were able to accurately synchronise their collectively felt stamping with the metrical pulse provided by my accompaniment on the electronic keyboard. In the interest of the group's motivation and rhythmic development, I introduced clapping as a variation on stamping which was to be performed in synchrony with the stamping. Immediately some pupils abandoned their stamping foundation, their well-established metrical pulse and focused on their own uncoordinated and fairly chaotic clapping. Realising that this may have constituted a retrograde step if I did not rescue the situation quickly, I demonstrated to the group that their clapping needed to match what their feet were used to doing and that the stamping was more important than clapping. With some encouragement and the need not to get this right straight away, the anxiety levels in the room gently subsided and one or two of the pupils began to find that yes, it was possible to match clapping actions to stamping actions. During that lesson, I learned that a sense of timing, for these pupils, seemed to be associated with control of the lower limbs.

As the cello lessons progressed, the group became proficient in several simple tunes and were able to synchronise stamping and clapping and chanting of the letter names of the simple tunes for example 'Three Blind Mice' was learned as:

'3…1…lift……, 3…1… lift……' or later: 'B…A…G……,B…A…G……'.

While these modest accomplishments seemed to be mundane in contrast with the progress of many other pupils outside this group, I was rewarded by the pleasure that this group found in learning. Learning seemed to be making sense for them for perhaps the first time. The delight in the voices of these pupils, as they successfully transferred the chanted version of a simple tune to their cellos, and were able to reproduce the notes straight away was very encouraging. Yelps of 'I can do it!' were a weekly treat for me as the teacher, but I too felt private relief and joy, for these were unexpected rewards in a series of lessons that were founded on no more than a curious blend of intuition and the desire to teach.

After about six weeks, I decided that the group was ready to develop some new skills. I had been apprehensive about using bows with this group because they are easily broken and the excitement levels in the lessons were always quite high. I also had misgivings about teaching the group to read music. I knew from their class teacher that their reading of text was very weak and I felt that an encounter with music notation might affect their overall confidence in playing the cello. I decided to combine an introduction to bowing with an introduction to music notation. I tried to instil in the group the idea that while bowing makes the cello sound much more interesting and varied, music notation can also provide access to new tunes that add interest and variety to cello playing. The pupils were doubtful about music notation but keen to try bowing. The sequence of skills relating to bowing was not at all problematic for the group. They enjoyed the new sounds that were available to them and proceeded to play their simple tunes crudely with the bow. I saved the stamping game until the end of the lesson. I suggested that the group stamped and clapped as usual but read the notes of a line of music at the same time. The group was doubtful that this would be possible, as reading music seemed to them to be very difficult. I eventually persuaded them that we would begin with the notes that they already knew very well: 'D' and 'G' (which are two of the four open strings). The music notation resource, 'Stepping Stones' (Colledge & Colledge, 1991) was used. This presents novice string players with an array of short, attractive pieces that require knowledge of only the open strings to begin with and then, notes in which the first finger is required to stop the open string are introduced. The open strings on a cello (and other members of the violin family) are spaced at the interval of a perfect fifth[1], the first note of the second half (tetra chord) of a diatonic scale:

doh, ray, me, fah, *soh*, lah, ti, doh.

The spacing on the stave (the lines on which the notes are written) between the open string notes allows the notes to be easily distinguished. The group were instructed to ignore the 'sticks' and just to concentrate on seeing which line the 'blob' part of the

[1] The open strings of a double bass are spaced at equal intervals of a perfect fourth which completes the first half (tetra chord) of a diatonic scale: *doh*, ray, mi, *fah*, soh, lah, ti, doh

musical note was placed. As demonstrated in figure 1., the notes are easily differentiated by their position on the stave as 'top line' for the note 'A', 'middle line' for the note 'D', 'bottom line' for the note 'G', and 'fallen underneath' for the note 'C'.

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[redacted]

Fig. 1.1 An illustration of the spatial organisation of the open string notes on the cello. Stepping Stones (Colledge & Colledge, 1991)

Having explained how to decode the letter names from the spatial distribution of the notes on the stave, I read through the notes with the group and made certain that each pupil had full understanding of the decoding process. I suggested that the group chanted the note names while playing the stamping and clapping game. They agreed and practised reading the note names, eventually with success in this way. Exhilarated by this achievement, the group were happy to apply this new reading skill to the remainder of the first page of the 'Stepping Stones' booklet. Following this encouraging beginning, the group made steady progress through the booklet and learned to discriminate between notation at eight different pitches, three types of time value (one beat notes, two beat notes and three beat notes) and two varieties of 'rest' (one beat rests and two beat rests). Each lesson was organised according to the same routine:

- Review of previous work,
- Simple tunes using the left hand fingers to stop the string,
- Bowing skills,
- Playing the simple tunes with the bow,
- Stamping, clapping and chanting while reading notation,
- Playing the cello while reading notation.

This structured approach meant that a pupil experiencing difficulty in a specific area of skill acquisition was unlikely to spend more than a few minutes tackling that particular area. Having witnessed the positive attitudes to learning within the group, I was aware that they were able to make meaningful progress if they were taught in a specific way. It became clear that the group were learning to play together with an astonishingly coherent sense of 'ensemble'. They seemed to have transferred their tightly synchronised stamping and clapping skills to tightly synchronised cello playing. Their bowing skills were fluid and they were able to read notation more fluently than most other pupils at the early stages of instrumental music tuition. It was at this point that I heard with some astonishment from two pupils that they now preferred to sing the note names rather than chant them as they had been used to doing. Their singing was focused and in tune, though a year earlier, their singing had been no more musical than an unfocused groan.

I gradually extended the range of skill development within the group and introduced the scales, arpeggios and pieces required by The Associated Board of the Royal Schools of Music for the Grade 1 cello examination. The group were somewhat aghast at this prospect! Instead of working towards a music examination, they chose to play in their school assembly in the presence of pupils, teachers, parents, OFSTED inspectors and the headteacher. The success of their first performance boosted the morale of the group and also generated a degree of wonder among colleagues. Additional performances in assembly followed and the pupils' sense of themselves as 'stars' was affirmed by encouraging feedback from their friends and their class teacher.

1.1.2 Observations from within the music studio

During these group cello lessons, I had watched the faces of the pupils as they struggled to achieve control of their stamping, struggled to coordinate clapping with stamping and finally as they combined these skills with the decoding of music notation. During these moments of observation, I remember speculating that a form of regulation was taking place within each individual pupil. The need to pull every limb and every sensory impression into time with the external beat seemed to generate sufficient demand upon concentration for the mental faculties of each pupil to be synchronised into the regulating effect of the metrical pulse. I suspected that the effort of stamping was likely to be fundamentally important in this process because it seemed to send a strong impulse through the balanced structure of the upright body that required unanimity of focus and intent. I was intrigued that the reading skills developed by this group seemed to demonstrate some transfer of the physical 'temporal regulation' to mental 'temporal regulation'. I concluded that in some way the learning outcomes, that I had witnessed, appeared to be directly associated with 'timing'. By engaging in a metrically organised physical activity, the group had inadvertently focused on a metrically organised aspect of mental organisation. This teaching strategy appeared to have diminished the difficulties that the group had expected to experience with reading and indeed learning.

I have continued to teach the cello in schools, and during subsequent years of teaching I have applied the stamping, clapping and chanting strategy whenever I felt it was appropriate to do so. The criteria that I have used to determine when to apply this teaching strategy have been:

- When the pupil is unable to clap in time with an external metrical pulse,
- When the pupil loses their place on the page frequently,
- When the pupil is particularly lethargic and unable to focus their concentration,
- When the pupil is particularly energetic and unable to focus their concentration.

I have noticed that the first two items on this list are nearly always presented together and with either the third or fourth items. One pupil had struggled with reading notation for several years before becoming one of my own students. Her sheets of music notation were almost obliterated by pencil marks where her previous teacher had written 'keep going' or prompts to remind her which note or finger to play. As I watched this pupil read, I noticed her eyes flickering rapidly from side to side. I felt doubtful as to whether the metrical stamping, clapping and chanting teaching strategy would sort out a noticeable eye-saccade irregularity. After a few weeks of lessons that incorporated the strategy, this pupil reported that she felt 'as if something inside her had clicked into place'. I encouraged her to try to play from music and we were both rewarded by her ability to read the music fluently. The irregular eye-saccades appeared to be behaving normally enough for uninterrupted reading to proceed. This pupil reported that her text reading had also improved in a similar way. In general, pupils that benefited from the stamping, clapping and chanting teaching strategy became able to read without losing their place on the line of notation and also became able to feel the metrical pulse as a regular internal beat.

1.1.3 Observations that project beyond the music studio

For the focus of this study, I might have chosen to investigate particular musical difficulties that are associated with a weak metrical pulse such as erratic physical coordination, difficulties with clapping and counting 'in time', secondary issues such as fluency in reading, poor self-esteem and self-consciousness.

During the years in which I applied the stamping, clapping and chanting teaching strategy I became increasingly aware of temporal organisation as an issue in learning more generally, as well as in reading. I became intrigued by the possibility that temporal organisation within the mental faculties might be an area that may be developed for improved learning and reading. As I pondered upon the phenomenon that I had become accustomed to witnessing I began to ask myself the following questions:

- Did stamping improve learning and temporal organisation in the group?
- Was stamping particularly effective?
- Was stamping actually causing an effect or was another element of the strategy possibly causing an effect?
- Did the group experience an improvement in their academic work as a result of these activities?

My own observations led me to consider that temporal organisation in the form of improved regularity which I term 'temporal regulation' through stamping, clapping and chanting, could lead to either an improvement integrated behaviour or what I describe as 'temporal integration' in an absolute sense. By undertaking a research degree, I took the opportunity to test these ideas in a formal and rigorous context.

1.1.4 Temporal organisation as 'temporal regulation'

'Temporal regulation' I suggest begins with recognition and appreciation of regular temporal intervals occurring between external events, perceived visually or aurally. A conscious effort is made by the individual to predict the regularity of the ongoing external temporal interval and to organise their own body to respond synchronously with the regularity of the temporal intervals between external events. Maintaining the synchronous relationship between the individual and the external stimulus arguably requires less conscious effort.

1.1.5 Temporal organisation as 'temporal integration'

My teaching experiences suggested that the process of 'temporal regulation' involved an intuitive or instinctive response to a regular metrical pulse such as provided in the music lessons. Nevertheless, I observed extreme physical awkwardness demonstrated by the pupils as they responded to the metrical pulse of the music. For example, while 'temporal regulation' allowed the pupils to respond synchronously by stamping in time to the metrical pulse with their feet, a simultaneously clapped response using their hands and upper body was incoherent, lacked ease and physical control. A period of further practise of stamping in synchrony with the metrical musical pulse followed; the physical awkwardness of the upper body and upper limbs was replaced by ease and fluent control. This change was not gradual but sudden and, as each individual felt the moment of change occur, they each expressed surprise. The clapped response to the metrical pulse became synchronised with the stamped response of the lower limbs indicating that integration between temporal control of the lower body and temporal control of the upper body had been acquired. Similarly, physical awkwardness occurred when the pupils attempted to chant the letter names of the music notation in synchrony with their integrated stamped and clapped responses to the metrical pulse of the musical accompaniment. Although the correct letter name was known to the pupils, the task of enunciating vocal responses in synchrony with the stamped and clapped response to the metrical pulse resulted in a disintegration of overall physical control, previously attained. However, perseverance and practise resulted again in a moment of sudden change in which vocal enunciation became integrated with the previously integrated clapped and stamped responses. When this process of integration was completed, I suggest the pupils experienced 'temporal integration' of the whole body, including vocalisation and reading processes involved in decoding the music notation.

The transformation that I have described here might be regarded as an approach that may possibly help some pupils to overcome difficulties with reading that are specifically related to issues of temporal organisation in terms of temporal control. The existence of 'temporal regulation' and 'temporal integration' as elements of temporal organisation need to be questioned, tested, challenged, established and reviewed through a thorough and rigorous empirical investigation in the context of resolving reading difficulties that may be related to 'timing' issues.

Part Two

1.2.1 Existing strategies to remediate reading difficulties through exercise programmes

To date the observed regulating effects of synchronised metrical stamping, clapping and chanting while reading music notation have not been investigated or documented. It is possible that some learning difficulties that are thought to exist among some school pupils are indeed related to problems that may be associated with an impaired sense of temporal organisation.

D.D.A.T.

Controversial claims have been made in the national press with regard to scientists and psychologists working for the millionaire, Winford Dore in his D.D.A.T. (Dyslexia, Dyspraxia and Attention Deficit Treatment) clinics. The D.D.A.T. programme is claimed by Dore and his colleagues 'to cure' dyslexia, dyspraxia, A.D.H.D. and A.D.D. by systematically stimulating the cerebellum through a series of exercises that demand ever-increasingly complex balance, co-ordination and cross-lateral skills on the part of the client. These potentially misleading claims attracted publicity in the media and were published in the national press amid much controversy (Wilce, 2003; Berliner, 2003). The aim of the D.D.A.T. exercise treatment programme is to strengthen the cerebellar networks so that they operate optimally and are able to function with an improved level of efficiency. This exercise programme has been associated with researchers Fawcett & Nicholson who propose in their 'Cerebellar Deficit Hypothesis'[2](Nicholson, Fawcett & Dean, 2001) that the cerebellum (which has been identified as the organ of regulation and co-ordination by a number of neuroscientists: Ivry & Keele, 1989; Ivry, 1993; Ivry 1996; Poppel, 1997; Poppel & Logothetis, 1986; Poppel & Wittman, 1999) is functioning less efficiently in the dyslexic brain than in the non-dyslexic brain of parallel intelligence. A

[2] The more traditionally held view of developmental dyslexia (Thomson, 1997) is that a dyslexia diagnosis applies to those presenting a deficit in phonological processing skills that is associated with poor auditory memory and poor sequencing skills. This view is thought to be linked in some unspecified way to right hemispheric dominance and often cross-laterality, which contributes to directional confusion and other problems such as hand-to-eye coordination.

study by David Reynolds and his research team was conducted to test the efficacy of the treatment programme. A tirade of criticism (Richards et al., 2003; Singleton & Stuart, 2003; Mc Philips, M., 2003; Whiteley & Pope, 2003; Fawcett, 2003; Stein, 2003; Snowling & Hulme, 2003) of the experimental methods followed the publishing of this paper (Reynolds et al. 2003). These issues will be discussed in Chapter Three (section 3.2.4).

Brain Gym and Eurhythmics

As well as the D.D.A.T. exercise programme, which is available at D.D.A.T. clinics, the presence of various remedial learning support projects in schools such as 'Brain Gym' (Dennison & Dennison, 1989) and 'Eurhythmics' (Bachmann, 1993) have received a positive response from teachers with whom I have discussed these issues (see Chapter Five, section 5.3.2). This positive yet anecdotal response may indicate that a link exists between movement exercises and improved reading and learning among schoolchildren. Claims for the benefits of exercise programmes such as 'Brain Gym' are underpinned mainly by anecdotal evidence; there is a lack of hard empirical evidence, theory and rigorous research in this area.

1.2.2 'Timing' in remediation studies

Recently published research papers (Overy, 2003; Smith et al. 2002) have raised levels of interest in issues to do with 'timing' in relation to children that experience learning difficulties such as developmental dyslexia and A.D.H.D. Each of these studies have alerted practitioners that 'timing' may well be an issue of practical application in the alleviation of symptoms for children that have been diagnosed with specific learning difficulties.

A.D.H.D.

Findings in a study by child psychiatrists and psychologists suggest that a temporal deficit theory might be applied to a group of children in a co-morbid group that experiences both difficulties with reading and have also been diagnosed with A.D.H.D. (Smith et al., 2002). In the hypothesis underlying this definition of A.D.H.D., the researchers propose that a 'dysregulation' of the central noradrenic networks contributes to the impulsiveness and lack of inhibition typically present in children suffering from this syndrome.

Developmental dyslexia

Similarly, a study (Overy, 2003) on problems with 'timing' among children that have been identified as being dyslexic has been theoretically underpinned by the 'Cerebellar Deficit Hypothesis' (Nicholson, Fawcett & Dean, 2001) described earlier with reference to the D.D.A.T. programme. The study by Overy (2003) on problems with 'timing' among children with dyslexia-type difficulties did not demonstrate a causal relationship, but it did strengthen an argument for multi-sensory musical intervention for dyslexic children.

Parkinson's disease

Work has been done in neurological investigations to do with temporal organisation. These studies compare the symptoms of patients with disorders in which 'timing processes' are affected, such as strokes and Parkinson's Disease, (Prassas et al. 1997). These types of investigation have revealed that certain areas of the brain such as the basal ganglia and the cerebellum are important for the normal functioning of the timing and coordination of movement, speech, and the discrimination of duration. Thaut has shown that using the metrical pulse in music as a regulating tool will prompt Parkinson's Disease patients and stroke victim patients to overcome difficulties with the initiation of a walking rhythm and will also regulate the fluency of their gait, (Thaut et al. 1996; Keynon & Thaut, 2003). These findings are discussed in Chapter Two, sections 2.6.1; 2.7.1.

Part Three

1.3 Placing reading fluency in a temporal framework

As well as investigating temporal organisation, my focus in this study is concerned with fluency issues in the reading behaviour of school children. Direct measurement of temporal organisation in reading behaviour using neuro-imaging is not possible for practical reasons. Neurological studies on timing provide links between processing in music and language which may contribute to a theoretical framework for timing in reading fluency. The literature available on 'timing' in neurology (Szelag et al, 1996;

Fraisse 1978; Turner & Poppel, 1988;) discussed in Chapter Two (section 2.6.2), provides links from the empirical evidence, gleaned from neurological models, neuroimaging and experiments (in time discrimination and performance in 'timing') to 'aesthetic timing' in the arts such as music and poetry.

Timing in Internal Rhythmic Structures

Interestingly, neurologists (Schleidt & Klein, 1997; Gerstner & Fazio, 1995,) have noted that vigilant animal behaviours observed in natural habitats, appear to demonstrate that a common time frame of 3-5 seconds duration, (defining a phenomenological sense of 'the present') may exist between species. During the discussion of these findings, Gerstner & Fazio (1995) speculate that this common time frame of 3-5 seconds duration, between different animal species, might be associated with the regular emission of the neurotransmitter dopamine. Similarly, Gerstner and Goldberg (1994) found evidence of a 3-5 seconds time constant in movement sequences across species. In findings by Graybiel, (1990) dopamine has been shown to be a secretion associated with temporal regulation by the basal ganglia at time intervals of 3-5 seconds (in a normal, healthy human brain). This 'timing' phenomenon may constitute that which phenomenologists have subjectively defined as a perceptual sense of the 'present' (Husserl, 1966). Correspondingly, the temporal parameter for the conveyance of meaning in a single line of poetry, in a single musical phrase according to neurological studies is also between 3-5 seconds (Wingfield & Nolan, 1980). Gestalt psychologists refer to 'good continuation' and 'goodness of form'. Jones and Yee (p.75) cite Bregman's assumption that at a preattentive level, automatic perceptual organisation using Gestalt proximity rules applied to frequency and time yields stream segmentation of tones.*'* The Chomskian chunking theory, may also apply here if information that is read and segmented ('chunked') may be presumed to aid the working memory in the organisation and sequencing of information. Similarly Jones and Yee (p. 80-81) refer to the 'Chunking Region' (CR) to describe the tendency for lower frequency velocities to form 'precepts of temporally discrete groups (chunks) of repeated tones (e.g. frequency proximities)'. Perhaps this mechanism operates within the common window of 3-5 seconds duration as suggested by Poppel and Wittmann's (1999) description of 'integrated beats' described in Chapter Two section 2.6.2.

Timing in internal rhythmic structures of music and language

The segmentation process, referred to by Overy (2003), by providing internal rhythmic structures promotes fluency of language and music, (Mursell, 1971; Vos, 1973; Repp, 2000; Molino, 2001) is described below by Swanwick.

> 'Musical fluency is what matters here. The music will never be constrained by the analytical schemes of written notation.... tones become tunes, these expressive gestures are interrelated in new forms', (Swanwick, 1999, p.67)

In this instance, Swanwick (ibid) firstly describes the internal rhythmic structures as a segmental process by which 'tones', are chunked together as 'tunes' and secondly how the 'tunes' are realised by the composer, the performer and the listener as 'expressive gestures' that come to be perceived as 'forms' in their own right. This process that may be described as encapsulating both the concepts of 'good continuation' and 'good form', is for Swanwick (ibid), the main constituent of 'musical fluency'. A parallel concern for 'good continuation' and 'good form' as gestalts may also be observed in research of internal rhythmic structures in children's listening and storytelling behaviour:

> 'Children encode stories in memory not as individual word pieces but as segmented, rhythmic sequences. At the time of retelling or recital of stories, children draw upon the rhythm and flow of language in the story and also upon their sense of how stories in general are structured....., (Chittenden, Salinger & Bussis 2001, p.55).

This description may indeed correspond with Chomsky's own observation of what he termed, 'intuitions about linguistic form' (Chomsky,1975, p.62). These 'intuitions' constitute the tacit knowledge of the internal rhythmic structures of a language, enabling that language to be spontaneously spoken. Verbal memory is likely to be a component of such 'intuitive knowledge'.

According to Neisser (1967), internal rhythmic structure as a grouping device, is a powerful facilitator of verbal memory. He hypothesized that the syntactic organization of language is an integrative structure that facilitates speech, much in the same way that a rhythmic pattern facilitates digits. In an ambiguous sentence 'They are eating apples' the rhythmic stress on the word 'eating' and subsequent grouping with the word 'apples' indicates that 'eating' in that sentence functions as an adjective. If the rhythmic stress is not on 'eating' then 'eating' is understood as a verb and is rhythmically perceived with 'are', (Neisser, 1967, p.256-257). This process of grouping, or segmenting, described by Neisser (1967, p.262), provides 'phrase markers' which represent an internal rhythmic structure, and by doing so, improve memory span. Nevertheless, critics of Neisser's work have protested that the idea of 'phrase marking' provides an inadequate method for describing the syntactic structure of language (Bever, Fodor & Weksel, 1965a, 1965b, cited in Neisser, 1967, p.267).

Helpfully, Chomsky describes syntax as the study of linguistic form and semantics as being concerned with 'meaning and the reference of linguistic expressions' (Chomsky, 1975, p.57). I suggest that fluency, may be described as the interdependence between syntax and semantics, and that grouping, segmenting, phrase marking and internal rhythmic structure are fundamental constituents of fluency in both linguistic and musical expression.

Timing in literacy

Sentences and phrases belonging to genres and idioms of language, are context specific and accompanied by inferences, overtones, and assumptions. The richness of communicative language (and of music) described by aesthetics, is defined when meaning and expression are invoked through the rhythm and the intensity of the voice or instrument. The sharing of expression and meaning through rhythm and fluency implies an intuitive and shared understanding of cultural knowledge, acquired in early life through oral transmission. In literate societies, the oral transmission of cultural knowledge gives way to written forms in books, the internet or in newspapers. As Chittenden, Salinger & Bussis (2001) explain, the spoken version of language and its corresponding written form demand a particular rhythmic-linguistic adjustment on the part of the reader. They distinguish between learner readers for whom the 'shift' is a subtle and often unnoticed as an adjustment in the fluent reading and understanding of a language, but for other novice readers, this adjustment presents a major obstacle in the acquisition of reading fluency.

> 'Although the spoken and written versions of a language are governed by the same basic grammar, writing is not simply speech written down. Writing is far more stylized than ordinary speech, and its styles vary tremendously. Not only do writing styles differ in such ways as suggestiveness, clarity, and logical persuasion, they differ in aesthetic qualities as well, depending on how the author fashions the sounds and grammar of the language....Because the rhythms of writing not only depend on word sounds but are also created from the grammatical forms of a language, rhythmic and syntactic (phrase and clause) structures are necessarily related.'(Chittenden, Salinger & Bussis 2001, p.54).

This statement seems to support the idea that the rhythmical structures of 'fluency' described by Neisser (1967) may be described as the interface between syntactic and semantic structures in language. If, as the authors suggest, the respective rhythms and syntactic structures of versions of spoken and written language are indeed different, then this may well present difficulties for novice readers who are disadvantaged in this particular respect by a poor sense of temporal organisation.

Part Four

1.4.1 'Timing' as the central focus for this investigation

By undertaking this research project, I intended to investigate whether or not an improvement in temporal organisation might result as a consequence of practising the stamping, clapping and chanting music intervention strategy. Numerous facets of temporal organisation may co-exist within an individual, and temporal organisation is not directly measured by researchers. Therefore in this study children's reading behaviour will be explored as a possible indicator of improved temporal organisation.

Increased temporal organisation in reading behaviour might be shown in a number of ways. For example, temporal organisation may be demonstrated as synchrony with internal rhythmic structures of the text, through rate of reading, through accuracy of reading, through reading comprehension, through reading fluency. If reading fluency appeared to improve, then intonation is likely to become more appropriate and contribute more noticeably to the voiced contours of both syntax and meaning. Similarly, in the event of a possible improvement in reading fluency, pauses are likely to provide suitable cadence points and to be appropriately placed. Both a sense of forward movement and a sense of good continuation are likely to provide some momentum if fluent reading behaviour does emerge as a manifestation of improved temporal organisation. These elements of reading fluency are likely to impact in both temporal and aesthetic terms within and between phrases as segmentation processes are integrated by improved ability in the prediction and selection of syntactic and semantic cues.

1.4.2 Summary

While the issue of 'timing' has been explored by neuroscientists through neuroimaging techniques and in experimental work by child psychologists and psychiatrists, the issue of temporal organisation is relatively unexplored by researchers in education. The conflicting theories of recent years concerning learning to read and specific learning difficulties have generated heated debate. A small proportion of the energetic disquiet might be attributed to what might reservedly be described as a conflation between co-ordination and temporal organisation that appears to be particularly problematic within the 'Cerebellar Deficit Hypothesis' (Nicholson, Fawcett and Dean, 2001).

Co-ordination, (whether physical and or mental) I suggest, may be thought of as a schema composed of the elements of timing, sequencing and a lack of directional confusion. Exercises that are applied through remedial programmes such as 'Brain Gym', 'Eurhythmics' and D.D.A.T. assume that co-ordination and movement if practised assiduously will generate a generally positive effect (Reynolds et al, 2003). In my view, there has been no attempt to present temporal organisation as a constituent element of regulation within these programmes.

Having observed a possible effect of synchronised metrical stamping, clapping and chanting while reading music notation upon my pupils, I intend to focus in the area of 'temporal organisation', but 'movement' and 'co-ordination' will be areas of lesser importance in this investigation of the stamping, clapping and chanting teaching strategy.

My primary aims in this study are to form an initial understanding of temporal organisation in schoolchildren and to explore whether metrically organised stamping, clapping and chanting might resolve weakness in temporal organisation. The overall objective of this research project is to investigate the effectiveness of the music intervention described in Part One, specifically the effect of the music intervention on the temporal organisation of reading skills

<u>Research questions to be addressed in this study</u>

- Where pupils are experiencing difficulty with metre and reading fluency, can metrical stamping, clapping and chanting while reading improve temporal organisation in literacy?
- Which children in particular are most likely to benefit from this intervention treatment?

An interdisciplinary review of literature

Chapter two

2.1 Introduction

This review of literature is presented in three parts. Particular interest is drawn to 'temporal integration', a term that has been described in Chapter One (section 1.1.5) and which is also used to describe cognitive processes in dynamic attending theory. In this project, the term 'temporal integration' has described the processes that may be involved in improving subliminal rhythmic and metric responses in the reading behaviour of schoolchildren. First I discuss cognitive and behavioural literature relevant to a deconstruction of the stamping, clapping and chanting exercises into components of time, space, and impulse. The temporal aspects of reading are then considered. The third part of the review regards neuroscience in relation to issues of timing. A summary places the theoretical underpinning of the investigation in a cognitive and behavioural framework.

Part One

Stamping, Clapping and Chanting: An Ancient Learning Pathway?

2.2 Overview

The focus of this study concerns hypothetical temporal processes of cognitive transfer. Cognitive models provide the most appropriate framework for theoretically underpinning a behavioural study into temporal processes of cognitive transfer. A suitable model would describe a hypothetical progression between metrical stamping, clapping and chanting, and improvement in reading processes. The work of Jones and colleagues on dynamic attending theory offers a highly suitable framework for considering the necessary cognitive architecture involved in temporal processing. The theory of 'representational redescription' (RR) set out by Karmiloff-Smith (1986) provides an alternative cognitive model in which transformational processes are considered to operate. The RR theory identifies a process in which information which was previously inaccessible to consciousness develops accessibility to consciousness. These theories are predated by Croce's 'Theory of Knowledge Acquisition' (1900), later described as the 'Hierarchy of Knowledge'[1] by Swanwick (1994, p.29), which identifies a cumulative progression of knowledge acquisition from 'Sensory Matter' to 'Intuitive Knowledge' to 'Conceptual Knowledge'.

The three theories: 'theory of dynamic attending', 'theory of representational redescription', and 'theory of knowledge acquisition' share two main ideas. These are firstly, that cognitive processes are nested hierarchically and secondly, that cognitive processes are assimilated from sensory or intuitive or conceptual experience. These points are reflected in the organisation of Part One of this chapter.

The first section, 'Physical Movement - Sensory matter' includes the work of theorists that have associated music and movement with a positive effect on children's learning. This section is succeeded by a section on 'Rhythmic Gestalts - Intuitive knowledge' that incorporates psychological studies that have established the existence of innate temporal patterns, providing evidence of the brain's use of timing as an organizational tool. These organizational aspects are investigated in terms of temporal regulation (see Chapter One, section 1.1.4). An additional theme - the cultural legacy of stamping, clapping and chanting - is considered by exploring bi-pedalism in terms of balance, entrainment and proto-culture, particularly with regard to the ordering, sequencing, regulation and organization of higher functions such as language, music and logical operations. The final section of the hierarchical model, 'Succession: Conceptual Knowledge' describes how the temporally regulated and integrated patterns of incoming data appear to correspond with basic logical processes that contribute to verbal communication.

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[1] The 'Hierarchy of Knowledge' first appears in Swanwick, K, (1994, p.29) as a term describing the process of knowledge acquisition set out by Croce (1900).

2.3 Representational levels of accessibility to knowledge

Karmiloff-Smith's (1999) 'representational redescription' theory models levels of accessibility to knowledge. Although, 'RR', described as 'involving domain-specific phases', (Karmiloff-Smith, 1999, p.20) does not correspond with the domain-general perspective considered here, formatting of the representational levels describing encoded information at phases that become increasingly accessible to consciousness are highly relevant. I suggest 'temporal regulation' may be intrinsic to the process of 'RR' .

The process of 'temporal regulation' may occur within a spatial-temporal filter. The process may involve selectively encoding sensory data possessing sufficiently regular formatting between the entry point of data into the system at 'Level E1' and its transformation into 'Level E2' (Karmiloff-Smith, 1999, p.23) for redescription from consciously unavailable 'explicit information' to consciously available 'implicit information' (Karmiloff-Smith, 1999, p.16).

Similarly, 'temporal integration' may correspond with 'RR' between 'Level E2' and transformation into 'Level E3' which details the sequential encoding of representational data from consciously available but not verbally formatted 'implicit information' to be transformed or redescribed as linguistic formatting for conscious access as 'explicit knowledge' (ibid). The following section traces the implications of RR cognitive theory for the music intervention.

2.4 Physical movement: 'sensory data'

Several theorists have shared the transformational theme of Karmiloff-Smith's (1999) RR cognitive theory. A model of perception presented as 'Table of Modes and Vectors' by Gardner (1973, p.101) analysed the significance of sensory movement in human aesthetic development. He referred to 'modes' as space oriented, as they are concerned with the sizes and shapes of sensory movement experiences and 'vectors' as the time oriented aspects of sensory movement experience. Gardner proposed that future aesthetic experience was configured from early experiences of 'modes' and 'vectors'. These space and time references imply that the perception of sensory movement experiences resulting from stamping, clapping and chanting might be usefully classified in these terms and also as residual reverberations in abstract spatial-temporal dimensions. It is possible to describe the sensory impulses of the stamping, clapping and chanting activity impacting upon perception by configuring these sensory experiences in a spatial-temporal matrix.

Theorists have also considered the processing of sensory movement impressions by the brain. Arguably, Gardner's matrix shares the concepts of time, space, weight and flow with Laban's 'Theory of Movement' (1971). Gardner used these elements of physical motion to describe the perceptual effect of sensory experiences, whereas Laban used them to formulate a vocabulary of measurable and classifiable concepts that define laws of dance movements (Maletic, 1987, p.22). The idea, coined by Laban, of 'movement sensations' (Laban, 1948, p.179) is related to the perceptual field of 'sensory matter'[2] but little was made by Laban of the consequence of these 'sensory impressions'[3] or their artistic effect upon the mind of the dancer.

Like Laban, Jaques-Dalcroze (1921 /1973) held the view that the rhythmic and dynamic elements of movement may be placed in a framework of space and time. Through rhythmic training, described by Bachmann (1993), Jaques-Dalcroze set about regulating the natural rhythms of the body. By achieving the automatisation of precisely organised rhythmic movement, Jaques-Dalcroze hoped to create definite 'images' in the brain which would become automatic responses to specific musical signals. Through the action of rhythmic movement, Jaques-Dalcroze aimed to train pupils to develop rapid physical reactions to mental impressions.

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[2] The term 'sensory matter' is used by Croce (1900) to describe sensory experiences in a slightly objective manner at the first level of knowledge acquisition.

[3] The term 'sensory impressions' is used by Swanwick (1994) to describe sensory experiences in a slightly subjective manner at the first level of knowledge acquisition.

Pre-empting the theories of Gardner, Jaques-Dalcroze recognised a need to explore the relationship between improved rhythmical control of bodily movement and specific features of cerebral activity. While Gardner (1973) linked sensory experiences with emotional and aesthetic expression, Jaques-Dalcroze (1921/ 1973) linked coordinated movements with improvements in concentration and imagination among his students. Interestingly, Jaques-Dalcroze and Laban fundamentally disagreed about the nature of rhythm and bodily movement. For Laban, music originated from the rhythmical movement of the body. For Jaques-Dalcroze, movement and dance were stimulated through musical rhythm. While for Laban, expression emerged as rhythmical movement from a sense of the geometry of physical balance, for Jaques-Dalcroze, expression emerged from controlled coordination in motor responses to musical rhythms.

The placing of bodily movement into a spatial-temporal framework is common to each of the theories of Gardner, Jaques-Dalcroze and Laban. The conveyance of sensory information into a spatial-temporal framework, has been described by Gardner (1973) as the function of a 'preverbal modal-vectoral chord' where modes are space oriented and vectors are time oriented. Similarly, Jaques-Dalcroze described the movement of the body as requiring a 'quantum of space and a quantum of time' (1973, p.37). However, Laban (1973) also described the dimension of impact in bodily movement, as he referred to the elements of time-rhythm in association with the elements of weight-rhythm and in so doing brought the accented and unaccented parts of movement sequences into relief. Like Gardner, Jaques-Dalcroze recognised the existence of a hierarchical progression from sensory impressions to the formation of mental 'images' encouraging an enriched imagination to develop. Indeed he speculated that stronger muscular movements would produce stronger mental images and an even more vivid imagination (1973, p.68). It is argued here that sensory impressions, may precede the acquisition of 'intuitive knowledge' and then 'conceptual knowledge', as outlined in the context of Croce's (ibid) writings on knowledge acquisition.

2.5 Rhythmic gestalts: 'intuitive knowledge'

Consistent with writings of Jacques-Dalcroze, Laban and Gardner, Jones (1981) associated spatial-temporal sensory information with a form of processing that facilitates a temporally organisational feature of knowledge acquisition.

'I propose that people actually generate subjective space-time paths of their own in response to certain features of the external stimulus pattern. These mental paths function as psychological expectancies. And it is through extrapolation of these mental spatio-temporal patterns that a person comes to anticipate where in space and when in time future events may occur. Expectancies, at least initially, are typically ideal or simplified paths. They are continuous, rhythmically generated paths that allow us to guide our attention to approximately correct neighbourhoods.' (Jones, 1981, p.571, cited Dowling and Harwood, 1986, p.167)

Authors Dowling and Harwood (1986) proposed the encoding of sensory data using a spatial-temporal matrix within sensory memory. Possibly inspiring the future redescription of representational data, later modelled by Karmiloff-Smith (1999), the authors described sensory memory as a store of complex information that is 'impossible to verbalise' and as occurring briefly within the 'psychological present' (ibid. p.180). Dowling and Harwood (1986, p.168) cited examples of information processing in sensory memory studies where findings indicated that although the span of the memory is limited (Miller, 1956), it efficiently processes sequences of sounds into chunks thereby capitalising on capacity (Fraisse, 1982).

Evidence for chunking as temporal grouping is suggested by behavioural experimental studies. Vos (1973, p.1-15) found that metrically structured sequences were subjectively perceived as 'accented' and 'grouped' into patterns. The groups of tones were perceptually formed into units probably as a consequence of the gestalt laws of proximity and similarity. Differences in strength of the tones were perceived, although there were no differences in strength in physical terms. The participants heard accents where there were none in actuality.

According to Vos, rhythmic perception is common to music and speech (Vos, 1973, p.1-15). Similarly, Molino (2001, p.165) has suggested that poetry, rather than being a hybrid of language and music, constitutes the form of something that predates both language and music. In particular, Molino (2001, p.172) has compared the articulation of syllables, the organisation of sentences and affective semantics with equivalent units in musical organisation. Similarly, rhythm has been defined by Repp as a sequence of sounds, whether musical or non-musical, according to its divisibility into perceptual groups and tendency to temporal regularity (Repp, 2000, p.235). The possibility that temporal ratios or patterns in rhythmic perception is common to music and speech is salient to this investigation.

In speech evidence from studies of pause placements (Cooper et al, 1978; Grosjean et al, 1979) suggested multiple time levels, but segmentation at a subtle word level indicated a hierarchical structure in cognitive temporal patterning (cited, Jones and Yee, 1993, p.103). Research conducted with children has confirmed that from the age of 5, children will imitate rhythmic patterns of a 2:1 ratio and return to the 2:1 pattern when attempting to reproduce a 3:1 pattern (Drake and Betrand, 2003, p.29). Temporal ratios, have been identified by Arom (2001, p.27), as proportioned articulations of an 'internal time frame' subjected to the regulating beat. Support for this view has been found in recent work on young children,

> 'When listening to a piece of music, we are predisposed to finding a regular pulse ...Once this underlying pulse has been identified it is used as an organizational framework around which other events are situated...'
>
> (Drake and Bertrand, 2003, p.26).

Fundamental to temporal perception, the same authors indicated that 'pulse' may represent a universal trait in rhythmic perception across cultures. In Javanese Gamelan music, the pulse is represented by a gong tone at the beginning of a cyclical pattern. Interestingly, the pulse is silent but nevertheless felt. In the Agbadza bell pattern of

Ghanaian music pulse is a strong silent impulse at the start of the pattern. The mnemonic for the Ghanaian Agbadza bell pattern is:

'n ken-ken-ke-ken-ken-ken-ke'

in which, according to Kwami (1994, p.49) and Wiggins (1991, p.26), 'n' represents the stamped or felt impulse that probably translates into Drake and Betrand's idea of 'pulse' (2003, p.26-27). A desire to understand universal traits found in the divisions and durations of rhythmic patterns in words and music has been eloquently expressed by Paynter who has asked:

> 'Are there principles at work deep in the nature of music ...and can those features be exploited as the basis of a musical education which will have a value for everyone?'(Paynter, 2002, p.215).

In sympathy with Paynter's view it is suggested here that 'sensory matter' or 'sensory impressions' were created by stamped impulses (as 'pulse') in cultural practices of prehistory, and have provided the temporal frame, or template, for the rhythmic gestalts that were described as 'subjectively accented' in the experiments conducted by Vos (1973, p.15). The following section describes cognitive models from entrainment to temporal processing as a hypothetical framework linking the temporal structure of the music intervention and the temporal organization of reading behaviour.

2.6 Cognitive models of entrainment: physical movement and temporal processing

The theoretical approach to entrainment modelling relies upon the assumption that a hierarchical structure of different temporal attentional levels becomes 'entrained' to rhythmic patterns in the environment. Computational models, constructed to model the internal attentional structure as nonlinear oscillators tuned to different frequencies excited by an acoustic stimulus have found that when one oscillator is entrained by one frequency, the stability of its response is variable (Large and Jones, 1999; McAuley, 1995; Large and Palmer, 2002, cited in Patel et al., 2005, p.231). When several oscillators become stimulated their combined frequencies (set at multiples of the fundamental frequency of the beat) couple together to promote a stable interaction within each other and a stable response to the environmental stimulus (Patel et al. 2005, p.231-232). In keeping with the natural laws of the harmonic series[4] in which oscillations are naturally coupled at frequency ratios of two and three times the fundamental frequency, neurologists have observed 'nesting' of one period within another (Large and Jones, 1999; Jones and Boltz,1989, cited in Patel, 2005, p.232).

Clayton, Sager and Will (2004, p.9) distinguish between coherent hierarchical arrangements between frequencies, as tempo or frequency entrainment, and phase entrainment which is more complex. Phase entrainment allows for phase-locking, detailing synchrony at a focal point. Both synchrony and anti-synchrony provide focal points for entrainment, illustrated by the authors in a description of normal human gait. Arguably, anti-synchrony phase-locking demands a richer sensory involvement and greater investment in attending by participants. Interestingly, children participating in the music intervention that experienced difficulty with the process of entrainment were helped when anticipation of the metrical pulse (the focal point of phase-locking in asynchrony) was emphasised. This was achieved by saying 'lift' to prompt the children in lifting their feet and thereby collectively experience the 'expectancy' of 'phase-locking in synchrony'. The inner cognitive processes of 'entrainment' have been described by Cross as:

> 'rooted in processes of pulse abstraction, processes that enable the optimal allocation (modulation in time) of attentional resources, that afford the basis for the experience of hierarchical structures in time, and that are intimately involved in the temporal control of periodic motor behaviour. Music as an interactive behaviour is thus founded on mechanisms that sustain the co-ordination of the timing of an individual's behaviours with those of others (either volitionally or reflexively), as well as affording means of synchronising the deployment of a

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[4] The harmonic series, a feature of Pythagorean mathematics and the 'music of the spheres' principle, enables a form of entrainment (e.g.: between the strings of the cello) to occur as sympathetic reverberation. The ratio frequencies that subdivide the fundamental may correspond to the ratios between interacting oscillators in human entrainment processes.

> participant's attentional resources with that of other participants, hence facilitating the collective…' (Cross, 2004, p.9).

The 'attentional resources' are highlighted in this description of entrainment as a form of temporal control. Automatic, reflexive locomotive responses to music, were demonstrated by Harrer and Harrer (1977, cited in Wallin, 1991, p.260). Their findings showed that an increase in impulses in the leg musculature was recorded while the subjects *sat* and listened to dance music. This reflexive effect of dance music has also been described by Wallin as:

> '…a reflection of a violent acoustical precursor to music as the initiator of the activities preceding dance' [that] 'influences the mid brain command neurons of the early bipedal man by inducing an 'acoustical nystagmus' via the vestibulary organ, phylogenetically in coupling with the cochlea organ and sensitive to impulsive stimuli... the strong coordination between the musical temporal parameters (duration, accent, pitch) and the movement of limbs, trunk, head and eyes - in their turn all correlated - indicates that the music has released a dynamic coupling of physiological, motoric and perceptual functions,' (Wallin, 1991, p.287).

An interesting debate surrounds the question of whether the neurological pathway, proposed by both of these writers, is common to other primates or whether it is specific to humans. An investigation of papers from biomusicology uncovered some disagreement on this topic. Nevertheless, these authors indicate that reflexive and integrative processes are implied by entrainment. The allocation of attentional resources in temporal organisation is explored in the following section.

2.7 Dances: gestalt formation

While the 'violent precursor' to music and to dance described by Wallin (1991, p.287) may well correspond with ethnographer, Sachs' (1937. p. 197) description of 'convulsive dances' as 'paroxysms of contortion and trancelike frenzy'; 'harmonious dances' are associated with joyful and pleasurable dancing. The dancers work in accord with their bodies as they coordinate all of the movements that they use into the regulating rhythmic impulses of the dance. The recreative imitation of animal movements in 'harmonious dances' provides a clear indication that there is a 'volitional' as opposed to a 'reflexive' intention between motor control, timing and the ordering of thought at this stage of cultural development. A hypothetical period of cultural transition from the reflexive style of dancing to the 'harmonious' style of dancing is likely to have had implications for the development of temporal control and regulation.

Laban described the significance of movement as part of the human understanding of the world (Laban 1948, p.189). According to Laban, every movement impulse prompts the body to abandon its vertical sense of equilibrium. The perceptual drive to recover the sense of equilibrium guides the mover to select a direction and a position that will enable them to recreate a sense of repose. A rhythmic sense of movement sequence is created in this way (Laban, 1925, p.363). In his theory of movement analysis, Laban looked at the spatial harmony of movement in conjunction with the dynamic rhythm of movement that he described as 'Effort'. According to Maletic (1987, p.179), Laban saw 'Effort' as the inner impulse that constitutes the link between mental and physical components of movement to produce 'living movement' such as in the 'harmonious dances' rather than 'mechanical movement' similar to the reflexive response described earlier by Wallin (1991, p.287). The link between mental and physical components of movement may distinguish 'harmonious dances' as an intended rather than an instinctive cultural activity. The symmetrical patterns perceived through participation in 'harmonious dances' would ensure, through the attentional focus required by entrainment processes, that binary properties of 'harmonious dances' were perceived at a hierarchy of attentional levels simultaneously.

2.8 Succession: 'conceptual knowledge'

The binary properties of 'harmonious dances' may be applied to a model describing 'temporal integration'. By combining the binary properties of the 'harmonious dances' with a model constructed from Swanwick's 'Hierarchy of Knowledge', it is suggested that:

- symmetrical and binary patterns of 'harmonious dances' can be classified as '*sensory matter*'
- the binary symmetrical gestalt patterns characteristic of many artifacts of aesthetic value can be classified as '*intuitive knowledge*'
- the acquisition of logical structures can be classified as '*conceptual knowledge*'.

These points are illustrated as new elements within the 'Hierarchy of Knowledge Acquisition', in figure 2.1.

In this study, activation of Jones and Boltz' 'ideal hierarchy' (as opposed to non-hierarchical, complex temporal ratio-patterns, Jones and Boltz, 1989, p. 466) is implied through cohesion between physiological locomotion and reading processes that undergo entrainment with simple binary time structures during the music intervention. An 'ideal hierarchy' consists of nested levels in a binary time structure, linked by a ratio time transform of 2 (Jones and Boltz, 1989, p.465). This is consistent with children's preferred time ratio of 2:1 described by Drake and Bertrand (2003, p.26) (see section 2.5). Furthermore, Clayton, Sager and Will (2004, p.9) described gait entrainment as 'synchrony' and 'asynchrony' in two 'phase-locked states', illustrating simple binary time structures employed at a physiological level, consistent with the bi-pedal music intervention. According to Jones and Boltz (1989, p.466) cited by Clayton, Sager and Wills (2004, p.15) human cognition processes entrainment, filtering attentional energy in three ways. Firstly, dynamic attending occurs in perception and by anticipating metrical focal points. Secondly, dynamic attending is refined through the process of attending and synchronizing with metrical focal points. Thirdly, dynamic attending incorporates adjustment and assimilation. Arguably, these primary processes in dynamic attending represent 'temporal regulation' of sensory representations of data (see figure 2.1)

Figure 2. 1: The Hierarchy of Knowledge Acquisition (Swanwick, 1994, p. 29) with consideration of the influences of temporality as intrinsic to each level of the hierarchy

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[redacted]

The process of 'temporal integration', also proposed here, describes the segmentation, or redescription of level E2 data (Karmiloff-Smith, 1999, p.23) into syntax based representations that are transformed to become accessible at a conscious level. Describing Jones' temporal perspective theory as an 'adaptive' process, Clayton, Sager and Wills, (2004, p.15) outlined two possible types of dynamic attending within a hierarchy as 'future-oriented attending' and 'analytic attending'.

In the 'ideal hierarchy' (ibid) in which nested levels in a binary structure are linked by a ratio transform of 2, individual focal points on a predetermined level are separated by a constant in time duration. 'Analytic attending' is proposed to occur when attention is oriented in a level where the focal points are separated by shorter inter onset intervals of time. 'Future attending' describes attention oriented in a level where the focal points are separated by longer inter onset intervals of time (Jones and Boltz, 1989). In a study comparing 'selective' with 'divided' attending, Klein and Jones (1996) investigated the ability of participants to attend to targets in both high frequency levels ('analytic attending') and low frequency levels ('future attending') across differing types of hierarchical structure. The findings revealed that 'divided attending' was most effective in binary time structures. The authors described the binary time structure as 'reinforcing a natural integrative bias', thereby 'facilitating an integrative process' that enabled the attender to link varying patterns of temporal duration, consequently dividing attention between different nested levels within the hierarchy (Klein and Jones, 1996, p.37, p.44).

Similar to the principle outlined in the description of 'harmonious dances', the music intervention under investigation here requires entrainment that is multi-sensory and furthermore incorporates reading processes with the binary temporal hierarchy of locomotive gait in two phase-locked states. Therefore the music intervention is proposed to activate a binary time structure, reinforcing a naturally integrative bias in the dynamic attending of the participants as previously demonstrated by Klein and Jones, (1996). It is proposed that the reinforcement of 'temporal integration' may benefit the segmentation or redescription of sensory data into temporally organised chunks implied at the E2 representational level (Karmiloff-Smith, 1999, p.23) and of intuitive knowledge (Swanwick, 1994, p.29).

Repetition of patterns is associated with 'future attending;' this type of attending was found by Jones and Boltz (1989); Drake, Jones and Baruch (2000) to correspond with simple binary temporal structures. The anticipation of repeating structures or successive patterns is proposed to correspond with higher cognitive function such as planning, foresight, judgment and proto-language function, see discussion in section 2.14.1, (Schmahmann and Pandya, 1997, p.42, 50). Logic based, conceptual knowledge implies the capacity to consciously accommodate structures and patterns as successive units of integrated meaning for further integration with prior concepts and logical structures, consistent with a constructivist perspective.

This analysis suggests the necessity for 'temporal integration' to be preceded by 'temporal regulation'. 'Temporal integration', I suggest, would focus successive events as distinct spatial-temporal points, clearly defined within units of perceived time, enabling 'succession' to function as the spatial-temporal framework for the acquisition of 'conceptual knowledge'. The interface between intuitive knowledge and conceptual knowledge is discussed in Part Two of this chapter in behavioural studies of spoken language and written language where semantic units are organised into distinct units of perceived time through a process described as segmentation.

Part Two

An exploration of literacy, language and timing

2.9 Segmentation and Phrasing

Researchers have found that the perception of both speech and music depends on the rapid processing of signals rich in acoustic detail and structural organization (Patel et al, 1998, p.717). This involves the generation of segmentation hypotheses, or the making of meaningful groupings of the sounds, during the perception of speech or music. Some of these processes may share a common neural infrastructure (Patel and Peretz, 1997, p.208). A correlation between 'song-rhythm tapping' and polysyllabic spelling scores has been reported (Overy, 2003, p.502) suggesting that segmentation processes are common to both of these skills. Studies of the development of speech and language comprehension have been found to follow a particular pattern in which,

> 'infants learn first words by joining with partners in cooperative awareness and action in the close sharing of gestures, facial expressions and vocal prosody of feelings or interests' (Trevarthen and Aitken, 1994, p.604).

The timing system for these gestures, the 'Intrinsic Motive Pulse', (Trevarthen and Aitken, 1994; Trevarthen, 1999) has been described earlier (section 2.7.2) as an emergent form of 'entrainment'. The marking of phrase boundaries in speech through intonation contours appears to be perceptually significant for infants (Jusczyk, Hirsch-Pasek et al. 1992). In empirical studies (Ladd et al., 1985, cited in Patel and Peretz, 1997, p.194) into sensitivity to intonation in speech perception, findings have shown that these prosodic cues remain significant as signals of intent and affect throughout the human lifespan.

There also appears to be a predisposition in infants to recognise melodic contours as meaningful in musical shape and syntax:

> 'The representation of contour information is so robust that 5-month-old infants can detect contour changes even when standard and comparison atonal melodies are separated by 15 seconds' (Trehub, 2004, p.5).

The structure of the phrase boundary retains its importance throughout life as has been demonstrated in studies of musical performance and perception. Researchers Schon, Magne and Besson (2004) found similar levels of performance in prosodic and musical discrimination tasks which suggested that music and language share mental structures for processing melodic and prosodic contour. Researchers Patel and Peretz (1997, p.203) have described studies in which phrase endings are associated with slowing down. The gradation in tempo becomes steeper when the boundary reflects more structural importance, in musical performance and perception. In a study on speech perception by adults, evidence for the lengthened phrase boundary as 'major-clause segmentation' was found by Wingfield and Nolan (1980, p.100), who examined this phenomenon under conditions of increased speech rate.

> 'Our listeners seemed not to be operating on a word-by-word basis, or on entire sentences or clauses passively held prior to any analysis. Rather, on-going speech processing seemed to represent a continual attempt to impose structure on the heard utterances with a preliminary analysis of each element in the speech stream being used to potentially confirm, reject or modify these initial hypotheses as to structure.' (Wingfield and Nolan 1980, p.101).

Apart from juncture or boundary lengthening, Wingfield and Nolan, (1980, p.101) added that prosodic features were also likely to influence the generation of segmentation hypotheses. This implied that the generation of segmentation hypotheses were formed according to the combination of melodic and rhythmic detail, as prosodic features, in the speaker's voice. Syntactic cues, concerned with instinctive knowledge of 'rules' of grammar, also informed the segmentation process as logical deductions may be made from particular verbs and prepositional phrases. The authors attributed this type of cue to,

> 'a fundamental interface between syntax and semantics' (ibid).

It is suggested here that such an 'interface' may represent the segmentation hypothesis *generating* stage as only one of a number of components in the segmentation process.

There is therefore a body of evidence to indicate that infants and adults are predisposed to respond, to recognise and to participate according to the perception and the production of contours in speech and music. The shape of the contours, signified by the meaning of the utterance and carrying embedded syntax, are significant to the infant. The early prosodic forms of communication between carer and infant are shaped by affect and rhythm. Interestingly, it is the right hemisphere of the brain that develops most significantly in the early post-natal period and it is the right hemisphere that is thought to integrate the prosodic system, sensitive to the perception of emotional expression (Trevarthen and Aitken, 1994, p.610-611). Nevertheless in spite of the natural predisposition of all infants to the recognition of, and sensitivity to contours and phrase boundaries, the investigations in the literature that follows, describe children whose reading of text lacks prosodic expression or phrasing.

2.10 Differences between spoken and written language – 'redundancies'

Storytelling involves the process of segmentation hypothesis generation to be regenerated. As a story is retold, Neisser (1967) believed that the same organisational elements required in the segmentation process are brought into play to facilitate the recall of events. Interestingly, the most powerful of the organisational tools of the segmentation process in story-telling, according to Neisser (1967), is rhythmic structure as a facilitator of verbal memory:

> 'Children encode stories in memory not as individual word pieces but as segmented, rhythmic sequences. At the time of retelling or recital of stories, children draw upon the rhythm and flow of language in the story and also upon their sense of how stories in general are structured…', (Neisser, 1967, p.235)

Trevarthen and Aitken (1994) and Trevarthen, (1999) describe how the infant learns to perceive spoken language (and later to recount stories) (Neisser, 1967) in a *top down* direction starting from speech contours through which vocabulary is arguably assimilated and defined by deductive processes based on context and affect signals in the speech contour.

Interestingly, when a child is taught to read at school they are generally taught through a *bottom up* approach starting from letters which blend into sounds to form 'phonemes' and then the child progresses to forming words or 'morphemes'. This stage of reading, 'decoding', involves the transfer of language from the aural to the visual modality. Subsequently, the child is required to make an intuitive 'leap' from decoding at a phonemic level, to learning to read the words as segmented chunks which, when grouped together, generate units of information. It is at this intuitive juncture in the process of learning to read, that the parallel between spoken language (phonemes) and written language (graphemes) breaks down. Phrase boundaries, naturally intoned by the voice in speech to infer the segmentation of words into phrases, are not supplied by the orthography of written language. Readers deduce this pattern for themselves. The process by which words are segmented into chunks as units of meaning, vital for the shaping of phrases, is unassisted. Visually coded forms of prosodic cue are not provided by the text.

As long ago as 1963, Fries highlighted the differences between spoken and written forms of language:

> 'In the graphic representations of language there are left out such language signals as intonation and stress and pause. These are important features of the signals of meanings....If one is to read with comprehension the graphic representations of the language signals, he must learn to supply those portions of the signals which are not in the graphic representations themselves. He must supply the significant stresses, pauses, and intonation sequences,' (Fries, 1963, p.130).

The elements of naturally spoken language, not supplied by language in its written form, are known as 'redundancies'. By applying stress, pitch change or, lengthening of phrase endings to written language during reading, specific small inflections may be logically placed according to inherent rules of syntax on words or syllables to impart the meaning for the whole phrase. It is suggested here that 'redundancies', being both time oriented and pitch oriented, provide parallel spatial-temporal (or time and contour) signals, that young infants have been observed to respond to instinctively in speech and music perception.

Schreiber, claimed that children rely even more heavily on prosodic features to form units of meaning from syntactic structures, when listening to spoken language, than adults. This factor may account for difficulties with reading fluency among novice readers:

'We predict that many beginning readers would not know how to put together into meaningfully related phrases, words which they can decode and which they could comprehend in the form of a sentence spoken aloud to them…'

(Schreiber, 1980, p.180).

In spite of the anomalies between spoken and written language, most children do learn to supply prosody and to compensate for the redundancies in the written 'orthographic' system. Most children do learn to read with 'expression' and fluency. However, the difficulties identified by Schreiber, though not encountered by most children, are found to occur among some children.

2.11 When fluency fails

A body of evidence considers that infants are predisposed to respond to melodic contour, to the rhythmic cues in language and music, and also that the subsequent formation of segmentation hypotheses is a natural and innate part of the development of speech perception. These features of speech perception also characterise reading processes. The issue of redundancies in orthographical representations of language has been identified as a potential obstacle to reading fluency (Schreiber, 1980; Chittenden, Salinger and Bussis, 2001). Although speech perception processes, such as the formation of segmentation hypotheses in the aural perception of speech appear to function well, some children seem unable to supply prosodic cues to compensate for the redundancies described earlier and to generate segmentation hypotheses while reading from written language.

For such an explanation to be plausible, in accordance with Wingfield and Nolan, (1980) and Neisser, (1967) any formation and generation of segmentational hypotheses would be influenced by the organisation of the syntactic and semantic 'interface' (Wingfield and Nolan, 1980, p.101) which would in turn be determined by the organisational flow of the rhythmic elements particular to the written style of the text. Put more simply, the contours of the text have a significantly different shape to those of speech and their rhythmic signature may be problematic or inaccessible for children who may be deemed 'uninitiated users' of written language.

Arguably written language may be more appropriately considered as a cultural genre of language rather than as an extension of the innate language facility. Perceptions of time vary from culture to culture, from style to style of writing. Difficulties with reading may not be primarily pathological (Ruckledge and Tannock, 2002) but cultural (Gibson and Levin, 1975, p.388). An investigation into this issue is beyond the scope of this study but the influences of culture and pathology will be considered in the final chapter.

2.12 Schemata

In speech perception, the idea of an 'on-going' generation of segmentation hypotheses formed by the listener while assimilating the meaning of a stream of spoken language utterances (Wingfield & Nolan, 1980) has been considered (section 2.10). In addition to these, the concept of 'schema' that has been described by Anderson (1992, p.469) as the listener's or reader's 'organized knowledge of the world' now follows. The schema is the background of experiences, beliefs and preferences that the listener or reader brings to every situation. The schema provides the foundation and the 'frame of reference' (Olson, 1972, p.141) for the tacit processes of comprehension, learning and remembering that enable the reader to engage with the ideas, the details and the message embedded in the listening process or, if reading, the text. The concept of schema has been described as,

> 'The flow of information, its acquisition, transmission, storage, retrieval and transformation in the learner's mind', (Staines, 1999, p.132).

A hierarchically managed network of stored information suggests that a form of interconnectedness probably exists within schema. Interestingly, Staines, (1999) identified the part played by pattern recognition in the abstract processes of information uptake:

> 'In being both abstractions from experience as well as representations of it, they [schema] facilitate pattern recognition and at the broadest level affect the amount of information an individual actually takes in.' (Staines, 1999, p.133)

If a pattern recognition process is indeed a component of storage, retrieval and recognition, in the abstract processes of knowledge acquisition, then the views, expressed by Staines (1999), Neisser (1967) and Trevarthen, (1999) described earlier, share the same fundamental rhythmic solution for the organization and transfer of information. The issue of rhythmic structure that Neisser (1967) has identified as a facilitator of verbal memory has been discussed earlier (section 2.10) in relation to segmentation processes. In the following section, neurological findings relating to temporal processing systems will be described.

Part Three

An exploration of neurological temporal processing systems

2.13 Processing systems

2.13.1 Cerebellar regulation

Currently, neurologists believe that the cerebellum governs the control of eye-movements, balance, the skeletal-muscular system and higher order functions such as the conscious temporal processing involved in rhythmic discrimination tasks (Molinari et al., 2003, p.317; Thaut, 2003, p.371). Trevarthen (ibid) described a perceptual body-map that links physical kinaesthetic knowledge with body-centred time and space. Similarly, neurologist Paulin (1997) stated that the cerebellum incorporates incoming data which is coupled with an internal representation, or map, to ensure that there are appropriate modifications in behaviours that operate in response to the incoming data (Paulin, 1997, p.518).

The regulatory function of the cerebellum has been described by Reis and Golanov (1997), who observed that the cerebellum regulates arterial pressure, heart rate and nerve discharge. Accordingly, Schmahmann and Pandya (1997, p.55) have found that the cerebellum regulates, 'the rate, force, rhythm, and accuracy of movements' and this may correspond with the finding that the cerebellum,

> 'possibly regulates the speed, capacity consistency, and appropriateness of mental or cognitive processes', (Reis and Golanov, 1997, p.55).

The discrimination of new rhythms has been found to be associated with increased activity in the cerebellum (Parsons, 2003, p.259; Bower, 1997). The sensory or cognitive processing (rather than motoric processing) of rhythm by the cerebellum has been found to be consistent with recent findings from investigations in neurology and neuroimaging (Parsons, 2003, p.252).

Experimental work described by Schmahmann and Pandya, (1992; 1997), Jones (1985) and Middleton and Strick (1997), has shown that the human cerebellum is connected to the cerebral cortex in a way that allows the communication of symbolic messages between the cerebellar and cerebral cortices by means of nerve fibres that are segregated into distinct bundles. Middleton and Strick (1997), and Schmahmann and Pandya (1997) have established that, in humans and apes, an area of the cerebellum called the dentate nucleus increased in size in parallel with and is connected to the frontal, parietal and temporal lobes of the brain. The dentate nucleus projects beyond the motor cortex to areas that are to do with higher cognitive function: conjugate eye-movements, planning, decision-making, foresight and judgment, as well as proto- language functions (Schmahmann and Pandya, 1997, p.42,50).

2.13.2 Temporal regulation

While investigating issues related to timing in the brain, references to a temporal relationship between the control of specific physical movements and higher cognitive functions: communication (whether musical or linguistic), planning, judgment and conjugate eye-movements were explored.

A number of studies have established that timing in the brain is constructed on two, interlinked levels, thereby achieving a subjective perception of time as a continuum. In a paper entitled 'The Reconstruction of Subjective Time,' Poppel (1996, p.166) argued that an illusion of the continuity of time is perceived because temporal processing is sampled from two independent processing systems that are hierarchically linked with one another.

This view is consistent with findings from cognitive psychology (Jones and Boltz, 1989) that the respective perceptual processes associated with rhythmic grouping and with metre are distinct, and that a dissociation between these two levels of subjective temporal organization has been demonstrated (Samson and Ehrle, 2003, p.206).

A study involving two models, that examined the effect of rhythmic gestalt on the perception of time were presented by Wittmann and Poppel (1999). The findings derived from the models showed that metrical beats were perceived as units, described by the authors as 'integrated beats', with a slightly lengthened beat at the start of each unit. The units were found to lengthen at lower metronome frequencies (slower beats) but the units never lengthened beyond 3 seconds. The paper described these automatic temporal integrations of individual beats as 'rhythmic gestalts'.

The aesthetic judgments of time in music, while infinitely flexible, are always performed within the parameters of rhythmic gestalt if they are to convey intelligible meanings. Turner and Poppel (1988) assessed the temporal constraints in poetry, spoken in different languages, and found that each line of verse was recited in around 3 seconds. Findings from Wingfield and Nolan (1980) confirmed that information processing in normal speech is segmented into 3 second intervals, revealing integration units that closely resemble metronome experiments (Szelag et al., 1996; Fraisse, 1978). The discussion that follows will consider two forms of rhythmic response. Both responses appear to be mediated by the cochlea and the auditory nerve.

2.13.3 Balance and spatial perception: the cochlea

In the neurological literature, the closest references to the processing of repetitive physical impulses are provided by researchers interested in the sense of motion in music. The sense of motion associated, specifically with the perception of music via the cochlea[5] (part of the inner ear complex), has been cited in Todd, 1999, p.117). According to Todd (1999), there are probably two distinct sensory-motor mechanisms that offer two forms of modality. He suggested that both of these neuropsychological mechanisms interact between the sensory-motor system and a sensory system. The first, Todd (1999) described as,

> 'an audio-visual-motor mechanism which combines the temporal and spatial filters, or receptive fields, with their respective frequencies' which is 'high-level, indirect and a product of learning' (Todd, 1999, p.116).

The second mechanism that Todd referred to is a vestibularmotor mechanism (to do with balance and therefore bi-pedalism) which, he suggested, functions in a 'low-level, direct and reflexive' way (Todd, ibid). By examining this vestibularmotor mechanism, Todd implied that a basic sense of motion, perceived through musical sounds, may stimulate automatic responses that imitate locomotion. A theory has set been out by Todd et al. (1999) in which a feed forward system that represents the movements of the musculoskeletal system, is portrayed as a dynamic model. This system mediates beat induction by blending the information from the feed forward system with low-level sound signals and then instructs the 'body' to synchronise its movements with the beat.

The auditory nerve has been suggested by Molinari (2003, p.317) to compute the timing events of this type of response by responding to neural excitation patterns that generate precise psychological coding enabling successful synchronization of body movement with the external beat (entrainment). Recent investigations (Tecchio et al., 2000;

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[5] The optic nerve, the oculomotor nerve and the various nerves that are associated with movement, channel through the vestibular labyrinth of the cochlea. The acoustic nerve travels from the cochlea to the brain.

Buonomano, 2000, cited in Moliniari, 2003, p.317) of cerebellar patients have supported a theory that peripheral processing of meter in entrainment activities, may be independent of the cerebellum, and may directly influence motor receptors in the cortex and at spinal levels (Moliniari, 2003, p.317). These findings suggest that this entrained timing response is not learned but universal (Moliniari, Thaut, Gioia et al.,2001, cited in Moliniari, 2003, p.317).

2.14 Summary

The theoretical underpinning of this study has considered cognitive mechanisms involved in temporal organisation to propose that 'temporal regulation' and then, 'temporal integration' may provide a learning pathway through which the music intervention is proposed to benefit reading behaviour.

2.14.1 Temporal Regulation

While the observation that 'temporal regulation' underlies the organisation of musical and linguistic thought may seem obvious or even naïve, an attempt to describe a hypothetical developmental route has been made here and summarised in figure 2.1.

The first level of redescription in 'RR' theory (Karmiloff-Smith, 1999) describes a process of transformation from explicit sensory information, inaccessible to consciousness to implicit, consciously accessible but verbally unformatted knowledge. The rediscription process implies the acquisition of intuitive knowledge from previously acquired sensory matter (Croce, 1900; Swanwick, 1994). Theory and evidence supporting this claim is drawn from research involving cognitive models of entrainment highlighting the salience of a nested temporal hierarchy around the transform ratio of 2:1 (Klein and Jones, 1996). This corresponds with behavioural research that demonstrates human preference for temporal patterning organised around the ratio of 2:1 (Drake and Betrand, 2003). The importance of bi-pedal 'phase-locking' in entrainment models is expressed by (Clayton, Sager and Will, 2004).

In neurology, two systems associated with 'temporal regulation' are described. The primary auditory cortices (known to detect discrete qualities of sound such as pitch and volume) recently have been found to be activated by temporal regularity (Griffiths, 2003; Moliniari, 2003). The processing of meter occurs in the right hemisphere. In addition, the cerebellum has also been associated with the regulation, discrimination and performance of rhythm; these temporal functions are associated with learning and adapting to new environments (Molinari et al., 2003, p.317; Thaut, 2003, p.371). Evidence for the existence of two separate domains for 'temporal regulation' is supported by a study that demonstrated at both cognitive and neurophysiological levels that entrainment to an external pulse may be either volitional or pre-conscious (Stephan et al, 2002).

'Entrainment', it is suggested here, may also be described as an interface between two forms of 'temporal regulation', where the unconscious response to the sound stimulus is dynamically juxtaposed with a conscious response associated with learning and requiring attentional resources. It is suggested here that a period of cultural transition allowing progress from the reflexive and pre-conscious, to the harmonious and volitional forms of dance may phylogenically underpin a possible dynamic relationship between the two systems of 'temporal regulation'.

2.14.2 Temporal integration

'Temporal integration' may contribute significantly to the organisation of musical and linguistic thought. The second level of redescription in 'RR' theory (Karmiloff-Smith, 1999) describes a process of transformation from implicit consciously accessible information which remains verbally unformatted, to explicit, consciously accessible, verbally formatted knowledge. This implies that the acquisition of logical structures as conceptual knowledge is dependent on previously acquired intuitive knowledge (Croce, 1900; Swanwick, 1994) but I also argue here that logical structures are dependent on the integrative function of temporal organization. The cognitive model of dynamic attending theory emphasises the salience of hierarchical structures in the formation of syntax and recognition of temporal patterning and phrase markers in speech and in music (Jones and Boltz, 1989). The importance of hierarchically nested temporal structures is supported by behavioural findings (Wingfield and Nolan, 1980) that identify the structure that listeners impose on the auditory stream.

The proposed pathway indicates a relationship between action and perception, beginning with stamping, clapping and chanting as the original source of this form of 'temporal regulation' and 'temporal integration'. According to Jaques-Dalcroze, the use of the term 'foot' to describe the rhythmic unit in Greek metre is common to most modern languages. The term suggests an association between rhythmic patterns and bipedal movement. This, says Jaques-Dalcroze (1921/1973, p.96), is not a coincidence but rather an indication of the Greek understanding of rhythm and its origins in movement. Jaques-Dalcroze preferred to associate, the rhythms of speech and music. He believed that natural rhythmic laws were common to verbal, instrumental and vocal rhythms (1921/1973, p.68).

I suggest, firstly, that the repetition of specific rhythmical patterns may correspond with the regulating framework that is recognised as the source of the 'intrinsic motive impulse' described by Trevarthen (1999). Secondly, I suggest that the neural networks of the cerebellum, described by Bower (1997), Bloedel and Bracha (1997), Paulin (1997) and Schmahann and Pandya (1997) are likely to function as a temporal regulatory mechanism linking the regulating aspects of rhythmic movement with the integration of the acquisition of conceptual from intuitive knowledge. Thirdly, I suggest that the actual rhythmic and structural patterns of ancient and traditional rituals and dances are likely to correspond directly with the gestalt patterns, described by Kwami (1994), Farrell (1990) and Sachs (1937) of Greek metre described by Molino (2001) and in the findings of experiments conducted by Vos (1973).

Three levels of knowledge acquisition were described by Croce (1900) and Swanwick (1994) and Karmiloff-Smith, (1999). Between each nested level, it is suggested that firstly, a process of spatial-temporal regulation and secondly, spatial-temporal integration, probably controlled by the cerebellum, facilitate the redescription and subsequent acquisition of knowledge by the next level in the nested model. Dynamic attending theory (Jones and Boltz, 1989) provides an explanation for the process of transfer between the levels: first by detailing entrainment as the process enabling 'temporal regulation', second by detailing transformation between levels of attending as the process enabling 'temporal integration'. It is hoped that Jones' model may provide a framework for the discussion of issues surrounding difficulties experienced by schoolchildren in reading and learning, through the investigation of a rhythm-based music intervention. Researchers, in the fields of neurology and cognitive science, have studied aspects of timing in spoken language and in music to establish whether a common timing mechanism might exist. In particular, Cross (2004, p.10) has noted that 'entrainment' processes involved in locking or latching onto the temporal pulse, 'for the members of any given culture may relate to prosodic features of their language'. By investigating the effect of the rhythm based music intervention on reading behaviour, it is hoped that this theoretical framework will be further elucidated by this study.

Methodology

Chapter three

The main stages of the development of the investigation into the effects of the rhythm based music intervention on reading behaviour are set out as four main sections in this chapter.

1. Conceptualising the study
2. Methodology
3. Design of the experiments
4. Processes concerning data

Part One

3.1.1 Conceptualising the Study

In the opening of this chapter decisions made in conceptualising the focus of the study, particularly elements of the area of interest that were investigated and the adopted approach are described. The stamping, clapping and chanting teaching strategy, as a focus for study, offered richness and diversity in a multitude of possible approaches. The decisions that have enabled the processes of refining and defining of this enquiry are explained here.

3.1.2 Operational Questions

The origins of this enquiry, developed from a teaching strategy, evolved in my work as an instrumental music teacher. All enquiry is assumed, stated Robson, to be, 'concerned with making a contribution to knowledge,' (1999, p.42). In this enquiry the central interest lay in exploring the effectiveness of the teaching strategy in relation to concepts of 'temporal integration' and 'temporal regulation' outlined in Chapter One (sections 1.4; 1.5). The purpose of this enquiry was to explore the effectiveness of the teaching strategy. It was decided that before attempting to explain what was happening, or, to describe what was happening, it was more important to establish whether an effect would occur following the implementation of the teaching strategy. This decision confined the line of enquiry significantly and deferred the descriptive and the explanatory questions surrounding this teaching strategy to 'future work'.

My experience with using the strategy in music teaching had led me to associate it with certain improvements in pupils' fluency when reading music notation. An unprejudiced view of how these effects might transfer to the reading of text was maintained. The exploratory nature of this study, stemmed from a personal sense of openness to the area of literacy development, but an informed and special interest in 'timing'. This study aimed to explore the interface between reading behaviour and 'timing', specifically 'temporal regulation' and 'temporal integration'. Research, particularly when concerned with alleviating reading difficulties, is accompanied by responsibility, and therefore the rigorous demands of disciplined investigation were welcomed in the approach to this study. The provision of meticulously generated data worthy of utmost scrutiny was a principal aim in this study. The specific limits of generalisation that may be drawn from the findings of this study were challenged and questioned. A context in which the generalisable aspects of this study may become absolute and clear has gradually acquired definition through a process of continual evolution.

The process of definition in this study might have been approached in any number of ways as the teaching strategy was multi-faceted, multi-sensory and holistic. The children that participated in this teaching strategy were simultaneously exposed to: music notation, a metrical pulse, a musical accompaniment, a synchronised physical activity and a reading activity. It would be possible to choose any one or combination of these elements as a research pathway. However, it was decided that all these factors were to be embraced as possible components of 'temporal integration', an abstract construct. It was decided that the operational aspects of 'temporal integration' would be investigated through assessing a variety of behaviours that may be considered to be indicators of 'temporal integration'. These behaviours included: the reading and understanding of text, rhythmic discrimination, and, rhythmic performance abilities. Through this approach, the desire to explore areas of musical ability and reading ability as components of 'temporal integration' within the same study was justified.

According to Robson (1999, p.43) case studies are appropriate for exploratory work. This assertion perhaps deserves qualification. In the instance of an enquiry within the social sciences, this statement may be valid. In a discipline such as psychology it is not difficult to achieve a conflation between scientific and philosophical findings unless stringent care is taken to adopt a scientific approach. The two tenets of the scientific approach are: (i) 'parsimony', in which the line of enquiry is as streamlined and efficacious as possible, and (ii) 'operationalism' in which the line of enquiry is organised to maximise replication in the future (Brainerd, 1978, p.11). These requirements are not met in a case study strategy and such an enquiry approaches a philosophical rather than a scientific paradigm. An experimental strategy would ensure that the scientific tenets of parsimony and operationalism are met.

Robson (ibid) offers the same types of research question for case study and for experimental strategies, namely 'how?' and 'why?' types of research question. In a case study the events, whether mundane or exceptional, that mark each study out as unique are employed as opportunities to engage with, and to embrace, reality. In an experimental approach, uninvited or unexpected events that may impact on the study are unwelcome. The study is likely to be contaminated or invalidated by such events. The main difference between the experimental and case study strategy is, according to Robson, (ibid) not whether scientific tenants are required, but whether the investigator has control over other events while conducting the line of enquiry. These 'other events' constitute the variables that may confound the findings if the research design has not been considered in sufficiently fine detail. Although the experimental approach may appear to be confined, limited in scope and defined by scientific rigour that can be difficult to attain in an educational setting, it was decided that this approach was the most appropriate for the exploratory work that was to be undertaken. The extraneous variables that might threaten the study were of uncontrolled behaviour: within the group of participants, the professionals within the schools, from myself as a researcher, also, external events such as crime, fire, flood etc. The effect of researcher behaviour was limited by reducing the contact time, during intervention sessions and testing sessions, to 10 minutes and to 20 minutes respectively. The performance abilities of the participants were assessed through a variety of appropriate measures, to be discussed. The professionals within the schools were informed through meticulous planning and frequent but brief consultations with regard to the progress of the study. My own part as an active researcher in the presence of the participants was limited to the operation of pre-planned and pre-organised items. Many instructions were pre-recorded to ensure minimal variation and personal interaction on my part. The threat of outside events beyond the control of the researcher was counteracted by a contingency plan which provided alternative sources of identical equipment and measures, should these be needed.

3.1.3 Qualitative-quantitative questions

According to Robson (ibid), exploratory research is often but not always conducted through a qualitative approach. I had, in the past, made qualitative-type observations from my teaching experiences while using the stamping, clapping and chanting teaching strategy. These observations included a number of mini-case studies in which I noted the difficulties experienced by a number of individual pupils with regard to reading music notation with fluency. Through these teaching experiences, I gradually developed an intuitive knowledge of the teaching strategy described here and an intuitive insight into the temporal aspects of music literacy. These 'qualitative' experiences helped to inform the research design and decisions concerning issues such as sampling and measurement in the investigation.

My qualitative and informally constructed case-study notes suggested that a beneficial pattern of outcomes seemed to be related to the teaching strategy described here but I was not able to demonstrate that the benefits that occurred in the pupil's musical capabilities were not the product of another process such as developmental maturation. I decided that an experimental approach, in which 'other events' were controlled, would generate quantitative, generalisable data on reading behaviour from which it would be possible to present the findings on a more objective basis. Nevertheless, I found that the measure of reading ability that provided the most appropriate form of analysis for the purposes of this study was not an ideal form of measurement to reflect the subtleties of 'temporal integration'. I therefore developed a quantitative measure of reading fluency, 'Analysis of Reading Fluency' that was included as a supplement to the quantitative data in the later stages of the project. My initial qualitative observations constituted a useful collage of background practitioner experiences but the observations were not included as part of this study. Quantitative experimental work was the main focus of approach for this study.

With respect to these entwined qualitative-quantitative approaches I constructed this study according to a logical stepwise progression. A combination of guesswork, logic, intuitive and inspirational thought best describes the process through which I have evolved both a theoretical framework and the research design; this is described by Mouly (1978, p.9) as the 'inductive-deductive' approach. In the inductive-deductive approach, the researcher adopts an inductive stance to begin with by constructing a preliminary hypothesis based on observations and on a review of the literature describing existing knowledge in the area of interest. The hypothesis is eventually systematically tested at an empirical level for its validation. The whole process incorporates experience, reasoning and research as three complementary and overlapping constituents. My observations and intuitive knowledge of the area of interest informed my preliminary hypothesis and decision to adopt an experimental approach. The review of the literature that I made on the basis of intuitive knowledge led me to construct a theoretical framework. In this theoretical framework, I drew on literature concerning 'temporal integration' from a range of academic disciplines including neurology, psychology, phenomenology, biomusicology, anthropology and literacy studies. While disciplines such as neurology exist in a realm beyond my own empirical capacities as a researcher, I found that neurological findings supported my theoretical stance and helped to inform the design of the study at various stages.

The three overlapping constituents of experience, reasoning and research led me to re-examine, re-appraise and re-define the parameters of 'temporal integration' in relation to reading behaviour and the teaching strategy described here. Just as compiling the literature review helped to define the theoretical framework, the initial findings, once interpreted, confirmed, enlightened and modified some areas of the original theoretical structure. Following the initial findings in Chapter Four, some adjustments concerning sampling and design were made (sections 4.3.1; 4.4.1) Similarly, as gains in reading comprehension emerged as a consistent finding, the general became more specific and speculative, hypothesised possibilities acquired clarity.

Part Two

3.2.1 Methodology

The practical issues that defined this study are examined here. Firstly, my specific role as the researcher in this study is explained. This section is followed by a discussion of the parameters of the study that related to both the organisation and the integration of essential components with regard to the inner workings of the investigation. Finally there is a discussion of factors contributing to decisions concerning the appropriate sampling of the population.

3.2.2 Methodologies: objective-subjective

This exploratory study was conducted according to the inductive-deductive research paradigm described earlier. The focus of this exploratory study, 'timing' in literacy among school children, is rarely mentioned in the field of literacy development. Similarly, the intensely physical and vocal elements that are involved in the stamping, clapping and chanting teaching strategy sit uncomfortably beside the peaceful and static activity of silent reading. The justification for investigating this noisy and extraneous teaching strategy has been made in Chapter Two (sections 2.2; 2.13) on phylogenic (anthropological / developmental) grounds (rather than as an emancipatory or cathartic approach to literacy development). I adopted a somewhat positivistic stance in this study which may provoke a degree of critical response. It was essential that I established hard empirical evidence that comprehensively tested and challenged the theoretical framework.

The study of behaviour has been cogently described by Cohen, Manion & Morrison (2000,p.3) as three different models of appropriate behavioural study, each demonstrating distinctive features. 'Normative research', is described as a top-down, somewhat cosmic approach to the study of the behaviour of society, and indeed, social systems. This 'normative' model is useful for researchers aiming to achieve generalisable outcomes or to explain causative behaviour. The 'normative' approach is impersonal and anonymous; the research is usually conducted from the 'outside' in an objective and clinical manner to maintain an ethos of accuracy for future replication. I adopted an extremely detached view of this investigation according to the tenets of the 'normative' model described here. By preserving replicable procedures and by assuming the detached demeanour of an 'outsider', I aspired to achieve generalisable outcomes from the findings in this study. This aspiration was founded on the premise that the investigation was conducted as an experiment with attention focused on minimising and controlling for variation within and between factors that interrelated with the effects of the music intervention under investigation.

While conducting the experimental elements of the investigation I adopted an impersonal and anonymous mode of interaction with the participants and also when handling the data. However, when planning the design of the experiments and constructing the theoretical framework, I became involved with the study in an entirely different way. When thinking about and focusing on the essential nature of the intervention activity from the outset, I aimed to achieve an informed, 'insider's knowledge' of the essential nature of this intervention treatment.

As a direct counterpart to the 'normative model', Cohen, Manion and Morrison (ibid) recognise 'interpretative research' as a model that allows the focus of attention to rest on the particular individual as a living participant in the constant recreation of social life. While the 'interpretative' process might be described as creative, it is also insightful. The 'interpretative' approach has, in this study, proved invaluable in helping to identify and access relevant and diverse areas of literature, and the identification, although indirectly, of experimental variables from the outset. Generally, the 'interpretative' approach relies on the personal and subjective involvement of the researcher with the participants and with regard to the processing of data that is generated during the investigation. An investigation of the 'interpretative ' type is usually conducted from the 'inside' in as sensitive a manner as possible. Without wishing to contradict my essentially positivist position, I deliberately and conscientiously aligned myself within the 'interpretive' approach when making informed decisions that concerned: theoretical framing, reviewing literature, considering design and sampling issues. However, I avoided the 'interpretative' approach when interacting with the participants or when handling the data generated during the investigation.

3.2.3 Validity, reliability, generalisability

In a positivistic study, such as this, the strength of the design is of utmost importance if the findings are to stand up to the rigours of stringent and critical scrutiny. In order to draw reasoned conclusions from the experimental findings, it was imperative that the research design was drawn with total commitment to the underlying issues that formed the theoretical framework of the investigation. It was necessary to explore the effect of the intervention treatment on randomly selected children so that I might be able to identify whether all children, or whether a specific group of children from a population with a particular type of temporal organisation in their learning profile or neurological profile might benefit from participating in the music intervention. Similarly, within the design of the experimental study, sensitivity towards aspects of the participants' behaviour that might mask any effects of the intervention activity was required.

Development in the design process to accommodate events in the research field stimulated general consideration with regard to the entire project. As an issue of cultural validity, consideration was given to whether the measures of assessment were appropriate for a particular population that may benefit from the intervention activity. For example, it was possible that the population that might benefit most from the music intervention might consist of those who, at a young age, did not have books read to them by their parents. Their vocabulary may consist predominantly of colloquial English which might not correspond with the more formal vocabulary used in the assessment texts. This cultural anomaly might have clouded or confounded any findings concerning improvements in 'timing' in reading behaviour.

Similarly, it was necessary to consider a localised peculiarity in which many but not all participants in a target school pronounce every 'th' consonant digraph as 'f' (onset and final) or 'v' (medial) (see Chapter 5, section 5.3.3). This local speech pattern was peculiar to only one school in this study and the reading behaviour of the participants reflected this local speech pattern. Within the experimental paradigm, when a participant effect (producing variation in patterns of speech and word recognition) arises it is likely to threaten the integrity of the study as a whole. By penalising the reading behaviour of this sample for incorrect mispronunciation, the fluency of the reading may have been underrepresented and the data may have been invalidated by this decision. If the method of collection of data was altered to accommodate the variation in this sample then the reliability of the data collection from this sample in comparison with other samples in this study and replications of this study would have been compromised. The solution to this dilemma was influenced by the introduction of measures of phonological awareness and a phonological awareness treatment at this point in the study. It was decided that mispronunciation of phonemes such as 'th' would be penalised but that a guttural half voicing of a final 't' such as in 'ca'' for 'cat' would not. In this way the local speech pattern would be recognised as a cultural factor but if the participants demonstrated a positive response to the phonological awareness treatment by correctly pronouncing the consonant digraph, 'th' this would be registered in the findings. In practice, the word recognition skills of the participants were weaker than had been anticipated. Errors in reading accuracy were usually made as substitutions rather than as mispronunciations, for example: 'threw' was read as 'thrown', 'the' was read as 'that', 'of' was read as 'on'. Generally, the concern about validity described here, was circumscribed because of the low word recognition levels in the sample. One participant, who read 'funder' instead of 'thunder' was penalised for this mispronunciation but this turned out to be an isolated event.

This experimental study was not conducted in a laboratory but in the real world which has a richness and diversity that the laboratory can never replicate. The challenge for the experimental researcher in the real world is to:

- Maintain the desire for generalisability through the design of the study,

- Reduce variation in every imaginable way,
- Recognise that experimental design imperfections due to the diversity of cultures in our society and real life events will arise and contaminate the design, even to a tiny extent,
- Remember that a larger sample will often offset issues of heterogeneity described above (Robson 1999; Cohen, Manion and Morrison, 2000).

The strength of a research design is determined by a vigorous examination of validity and reliability issues such as those described here. The applicability of the findings beyond the study sample, to the target population at large, is measured in terms of generalisability. A robust experimental design will stand up to critical scrutiny if the issues surrounding the validity and reliability of the investigation have been attended to while the outcomes of the study will have greater scope for generalisability if the strength of the design is strong.

The concept of validity is central to the integrity of the research in question as it enables confirmation that the findings are in reality as they are presented by the researcher in the context of the theoretical framework and operational questions. According to Robson 'internal validity',

> 'measures the extent to which a researcher may establish that a factor or variable has actually caused the effect that is found', (Robson, 1999, p.46).

In this study, that investigated the effect of a music intervention upon reading behaviour, the most reasonable and straightforward way of measuring the concept of 'construct validity' was by the assessment of how well the methods of measurement in the study related to the topic under investigation (Brown & Dowling, 2001, p.71). In this study, any beneficial effect following the intervention session was hypothesised to be attributable to the degree of 'temporal integration' that may be achieved via a process of 'temporal regulation'. However, measurements that directly correspond with the concepts of 'temporal integration and 'temporal regulation', which reflect executive brain functions, would require scanning techniques which are beyond the resources of this small scale research project. Moving laterally from temporal organisation as a directly measured behaviour, it was decided that 'reading fluency' and other elements of reading behaviour would provide an indication of temporal organisation. An issue of construct validity, arose concerning whether sensitivity to 'timing', in terms of rhythmic discrimination or reading fluency would be adequately represented by the standardised measures of assessment that were available for this investigation. A measurement of 'reading fluency' (Chapter 7; Appendix X) was constructed for this project since a ready to use measurement was not available. Other well-known, reliable measures that reflected improvements in other areas of reading behaviour such as accuracy, rate and comprehension were selected. A rhythmic discrimination measure that indicated a degree of temporal organisation and provided baseline information on the sample was adopted in this study.

'External validity' (Robson, 1999, p.46) reflects the degree to which findings may be generalised from the specific sample in the study to a sample population. In an exploratory study such as this, the target population was not previously defined or precisely known, the strength of 'external validity' was likely to fluctuate during the course of the study as more was learned about the specific nature of the target population. The degree of confidence with which a researcher may claim to have achieved a replicable investigation, described as 'predictive criterion validity', is a form of 'construct validity'. In this study 'predictive-criterion validity' was strengthened by employing well known tests of reading behaviour and rhythmic discrimination. While the real life context of the quasi-experiments provided considerable 'ecological validity' which would lend support to the generalisation of the findings, it was also plausible that the approach taken could have lacked precision for defining the target population with confidence, thereby satisfying the second research question. Ongoing refinement of the design of the study might have achieved this aim, though the desired level of precision was constrained by limits on the size of the sample and the uniqueness of each and every participant. Substantial participant effects in one school (Chapter 5, section 5.3.9) included weaknesses in decoding, inducing masking effects; problems with punctuality and attendance during the treatment sessions contributed to substantial concerns surrounding the internal validity of the findings at one point. The threats to internal validity were met by adjusting the experimental design to afford further opportunity for the participants to receive the treatments. Fortunately, within sample variation from other schools had higher homogeneity and more confidence could be placed in the external validity of the findings.

The strength of the validity of a piece of research is dependent on the reliability of the measures (Brown & Dowling, 2001, p.26). Threats to reliability include participant error, which may arise through variation in health, concentration etc, or observer error, which includes carelessness, or tiredness. Any ceiling or floor effects, due to the lack of correspondence between the capabilities of the participants and the level of difficulty in the test, were taken into consideration as the sequence of experiments progressed. This meant that the progress of the experimental sequence was not always determined by the research questions alone but rather by a process of accommodation and adjustment within the limitations of the assessment measures. In a similar way, problems relating to bias presented a strong threat to reliability. The experimental approach, with its emphasis on clarity, typically involves the simplification of any given situation but modifications in the name of simplification typically lead to bias. Bias, difficult to eliminate, is often present at an unconscious or subconscious level both in the participants and the researcher. Interestingly, findings from a study by Rosenthal and Rosnow (1975), (cited in Robson, (1999, p.81-82) have shown that volunteers who become participants in experimental research were more likely to be adversely affected, in terms of reliability, by the artificial pressures induced by the experimental situation than a comparable group of non-volunteers. The awareness, on the part of the participants, that they are being measured or observed and the artificial context of the social element of the situation (Orne, 1962, p.81) can lead to 'demand characteristics'. It is thought that the participants are able to present the researcher with the results that have been expected simply because the experimental conditions have had some inspirational effect rather than a desired concrete change following an intervention. This phenomenon is also described as the 'Hawthorn Effect' or the 'placebo effect'. The presence of 'demand characteristics' or 'experimenter expectancy effects' present difficulties for ascertaining reliability, as the findings may be more representative of unreliable individual response to the experiment, and the 'noise' from the experiment itself, rather than a valid representation of the issue in question. The first four experiments in this project involved the researcher administering the measures and directing the music intervention treatment on a weekly basis. The opportunities for the researcher to influence the outcome of the research through an 'inspirational effect' or for the participants to experience 'expectancy effects' were controlled in the final stage of the project. In the final stage of this investigation, described in Chapter Six, the music intervention was conducted by teachers and was investigated under trial conditions. The collection and the handling of the data was audited (section 6.4.1) to safeguard against 'experimenter expectancy effects'.

Fortunately all the experimental sessions were conducted in the school environment and during the school day. The participants were involved in the music intervention for only 10 minutes each week and it was unlikely that 'noise' generated by the 'real' context of these experiments would contaminate the findings. It was unlikely that participants in this experimental study would exhibit improved reading behaviour simply because they were inspired or encouraged by the experience of participating in an experiment. However, it was likely that 'demand characteristics' may have been present in terms of 'enthusiastic' reading. Enthusiasm in reading may be a factor in improved reading behaviour but improved enthusiasm in reading is usually accompanied by other constituents of prosodic reading behaviour such as improved phrasing or improved intonation. Gains in prosodic reading were most unlikely to be induced by 'demand characteristics' or by the 'Hawthorn Effect'. However, it was possible that other participant effects such as tiredness or illness may provide variation between and within the participants across the whole study. This type of problem affects all forms of pupil assessment in schools and was a further reflection of the degree of 'experimental realism' in this study.

According to Robson (1999, p.68) bias may also occur on the part of the investigator due to what are termed 'experimenter expectancy effects' or as 'recording bias' in which knowledge of the aims of the investigation may bias the way the results are recorded. This is also termed 'observer bias' and the bias may be drawn in favour or against the investigation. This type of difficulty can be resolved through standardising the data collection process. In investigations when interactions between investigators and participants are involved, it is possible to offset threats to reliability by using recorded instructions so that procedures are standardised whenever it is practical to do so. In this study, the participants' reading samples, which constituted the primary form of the data, were available as mini-disc recordings for auditing purposes and the measurements that were made from these recordings were collected according to the standardised procedure in the corresponding assessment test manuals.

Traditionally investigators seeking to adopt the 'nominative research' approach have opted for 'double blind randomised control trial' or 'double dissociation' experimental procedures, (Ivry, 1993, p.216-217) which are described by Robson (1999, p.81) as the 'gold standard' procedure for experimental investigation. While at a conceptual level this approach appears to be ideal, there may be, in educational research, difficulties in adhering to this procedure. Also known as 'double blind' experimental procedures, such practices are designed so that neither the person(s) conducting the research nor the participants are informed of the hypothesis or indeed the identity of the treatment and control groups. Such a procedure has been shown to provide the most effective means of ensuring against 'experimenter expectancy effects'. This topic has been addressed already and is also discussed by Rosenthal & Rubin, (1978, p.82) who point out, that researchers tend to unwittingly bias their findings to provide empirical support for their hypothetical framework. Perhaps in laboratory conditions where 'experimenter effects' and 'demand characteristics' are induced by the extreme artificiality of the context, it is necessary to offset these bias issues by adopting a 'double blind' procedure. Criticisms of the 'double blind' approach are of an ethical nature and focus on issues to do with honesty between the researcher and the participants and the issue of requesting full consent on the basis of participant ignorance of the investigation. I have not assumed a 'double blind' procedure for the following reasons:

- In educational research, where the study is conducted in a 'real' educational context, the problems of 'experimenter effects' and 'demand characteristics' are reduced through the authenticity of the experimental context in a classroom setting.

- In this experimental investigation, the participants were involved as members of a small group for only 10 minutes each week and my contact with them was both standardised and minimised by the use of pre-recorded intervention sessions.
- The participants were told about the aims of the study in an introductory letter and in a brief question and answer session at the start of the investigation. I deliberately intended that the children should gain some understanding of the design and purposes of the study that they were participating in.
- 'Temporal regulation' and 'temporal integration' hypothetically occur at a subliminal level without conscious awareness on the part of the participants; the measurements of any beneficial effect by the intervention activity would manifest regardless of the participants' attitude to the investigation.
- The music intervention was optimally conducted in small groups in the presence of a participating researcher who could monitor and stimulate the quality of the children's efforts. If this activity was to be used as a teaching strategy in schools to stimulate reading behaviour, then an identical approach would be recommended. For this reason, the high degree of experimental realism demonstrated in this investigation was important.
- The time constraints on delivering the National Curriculum in schools, presented ongoing pressures and challenges for many teachers. Issues of accountability dominated the educational landscape. Pupils and teachers needed to be seen to be achieving government targets. I was fortunate that teachers were prepared to release pupils for 10 minutes each week for participation in the intervention treatment. It was not possible to request the removal of pupils from their curriculum lessons to allow the control group to receive a treatment that would provide a commensurate level of special attention in order to off-set the so called 'Hawthorn Effect'. The control group participants remained in their usual class lessons which regularly involved working with a teacher in small groups.

3. 2.4 Sampling Issues

Although this was a small scale, exploratory study, and resources did not permit the use of a probability sample, the quality of the sampling process was likely to have a direct bearing on the strength of the design and the issues surrounding validity, reliability and generalisability. In terms of the resilience of the experimental design, the most reliable form of sampling is randomised sampling from a known population. It is important that the population is defined as the future generalisability of the findings will be applicable to this population and this population only. The main advantage of the randomised sample, is that members of each experimental group,

> 'have an equal chance of being influenced by factors other than the intervention'(Scott & Usher, 2000, p.58).

The music intervention under investigation here, was originally developed to assist pupils that had difficulties with a sense of metrical pulse or difficulties with reading notation with fluency. The group of pupils, described in Chapter One, section 1.1.1 were nine and ten years of age. The teaching experiences, influenced the decision that experimental sample would be randomly selected from nine and ten year old children. In Chapter One, section 1.1.2, I described use of the teaching strategy to help pupils with difficulties with a weak sense of metrical pulse and difficulties with reading musical notation with fluency. I did not know whether this teaching strategy might also benefit pupils with a strong sense of metrical pulse or pupils that happened to already read well. In music teaching, although I had restricted the use of the teaching strategy to the pupils that I felt would benefit the most from this type of approach, the teaching strategy might benefit all school children of that age group. For this reason I decided that the randomised sample for the study would be selected from the cohort of nine and ten year old children.

Following a pilot study, a sequence of four experiments was conducted; the participants were randomly sampled from the population of each of four schools located in regional urban areas, close to the researcher's home. This convenience is justified on two grounds:

- The provision of the National Curriculum, National Literacy Strategy and National Numeracy Strategy in the schools that participated in the study meant that these schools were representative of other schools of their type in this country.

- The original teaching strategy was developed in schools from this area and it was appropriate to conduct the research in schools from the same area.

Initially, the Music Services of two counties approached possible host schools on my behalf. The head-teachers of schools that expressed an interest in being involved in the investigations were sent sample consent letters and information sheets for the parents and pupils that might become involved in the study as participants. Meetings took place with either a music co-ordinator or with a classroom teacher from each school, to discuss timetabling for the experiments and arrangements regarding the consent letters. The consent letters were sent out to a random selection of pupils until a sample of 24 pupils was achieved. Pupils whose parents did not return the consent form were not included in the experiments. By declining the invitation to participate, the aim of achieving an absolutely random sample was somewhat compromised.

Threats to validity and reliability occur when 'selection effects' creep into the design due to sampling error or due to inadequate matching in certain group designs as described by Robson, (1999, p.46). Both of these effects were relevant to this study. The design incorporated two groups - an intervention group and a control group. They were matched by reading comprehension and rhythmic discrimination baseline scores to avoid a phenomenon known as 'regression to the mean'. The 'regression to the mean' phenomenon describes the migration of extreme scores of two divergent groups in pre-test measures to a statistical mean in the post-test measures. The effect is to produce a disadvantaged population in one group and a non-disadvantaged population in the other group. As described by Robson, (1999, p.103), the disadvantaged group that scores significantly below average scores is more likely to produce 'positive error factors' and the disadvantaged group scoring significantly above average scores is more likely to produce 'negative error factors'. It is the movement of the error factors due to their random distribution that causes the tendency to regress or migrate towards the mean. This phenomenon may be regarded as a 'selection effect' that induces a significant threat to internal validity, as recently observed by Richards et al. (2003, p.147) in their criticism of the 'exercise based treatment for children with reading difficulties' study by Reynolds, Nicholson and Hambly (2003) (see section 1.2.1).

Such 'sampling effects' may be avoided through the application of stringent care and attention to detail at all the appropriate stages of the investigation. To avoid these difficulties, randomised sampling is essential and the baseline measures need to be examined critically so that the sample may be divided into control and intervention groups that are indisputably matched in capabilities.

Part Three

3.3.1 Design of the investigation

Moving from the general to the specific, an examination of the rigour maintained to ensure the security of the investigation against threats to validity, reliability and generalisability is offered. The advantages and disadvantages of realistic as opposed to artificial experimental settings are discussed.

3.3.2 Operationalising factors and variables

The aim of the research project was to investigate whether participation in a music intervention had any effect on reading behaviour. The most convincing approach for this research would be an empirical study involving an experimental approach. This investigation is, to my knowledge, the first to consider temporal organisation, and in particular, 'temporal integration' in reading behaviour. The validity of the investigation was safeguarded by including controlled measures such as matched groups, pre-tests and post-tests, and standardised measurements and procedures where possible. Following the experimental period, trial conditions in which any 'experimenter effects' in the investigation were checked by having the intervention treatment conducted by school staff and also by having an audit performed on the data, which ensured validity.

The inferred 'dependent variable' in this study is a theoretical construct - 'temporal integration', achieved by means of 'temporal regulation' and hypothesised to demonstrate improved reading behaviour, particularly, improved fluency in reading. A convenient measure for fluency in reading was not available[1] therefore, fluency in reading was assessed by a number of measures that were perceived as possible *indicators* of fluency in reading.

Each experiment in this investigation involved the music intervention sessions being conducted within a fixed time period. A tape recording was used to provide the stimulus for the music intervention of 10 minutes duration in each intervention session which replicated the teaching strategy described in Chapter One (section 1.1.1). There were twelve participants in each intervention group, but the music intervention was administered to them as groups of six participants. There were twelve participants in each corresponding control group. The researcher had the task of monitoring the accuracy and commitment of the participants in the music intervention sessions in keeping with typical school activities (a sloppy, careless or ambivalent approach on the part of just one participant might have affected the outcome of the experiments). The researcher therefore motivated the participants when necessary in the intervention group. For reasons given earlier, the researcher did not interact with the participants in the control group. They participated in their usual lessons.

The music notation resource used in the music intervention corresponded with the music notation, used in the teaching strategy described in Chapter One, (section 1.1.2) and was selected from 'Stepping Stones' (Colledge and Colledge, 1991) (see figure 1.1). The pieces were selected for duple or quadruple meter, to facilitate the naturally binary aspect of bipedal metrical stamping. The intervention procedure was standardised in that the musical accompaniment was pre-recorded. The tempi of the musical accompaniments were standardised therefore, from session to session and from experiment to experiment. The music notation resources were selected to provide a progressive sequence of difficulty. The sequence was maintained from session to session and from experiment to experiment but differences between the intervention groups meant that the rate of progress through the sequence varied from session to session and from experiment to experiment. In each session the sequence commenced from the start of the booklet, but

[1] A measure of reading fluency, 'Analysis of Reading Fluency' has been developed during this research.

each week a new element was introduced before the end of the session (this procedure corresponded with the teaching strategy described in Chapter One, section 1.1.2). In the session, if a participant or a group of participants appeared to be seeking recognition of mastery in an element of the music intervention, they were invited to perform the music intervention on their own. Their efforts were always praised and the music intervention for the group was then resumed once again.

All participants were kept strictly to the task of metrically stamping until this became an automatic skill. Some participants required extra encouragement to attain this level of skill. The researcher's approach was light-hearted and kind, but businesslike. It was important to communicate to the participants that although this was a 'fun' activity, it was also to be taken seriously. The sessions, although only 10 minutes in length were very intensive and tiring for all concerned. It was important to have the participants' commitment and concentration. Guidelines for conducting the music intervention are set out in Appendix VII.

The fundamental principle of this experimental investigation was that any measured differences that existed between the experimental conditions would directly relate to any corresponding effect that occurred during the music intervention provided that all external influences were excluded. The intervention group participated in the music intervention while the control group participated in their usual class-work. Any differences between the experimental conditions were compared, by using the measures, collected from the whole sample, both before and after the intervention period. The experimental design was organised so that the effects of the intervention, (the 'dependent variables') measured as changes in reading behaviours and rhythmic response, did not coincide with the differences that occurred naturally between the participants, such as differences in reading behaviours and differences in rhythmic response (the 'independent variables').

There were three reasons for including pre-test and post-test measures. There was a need to control for residual 'sampling effects', which can be summarised as the degree of between participant differences in the sample following the 'matching pairs' procedure, at the pre-test stage of the research design. 'Matching pairs' (see Appendix IV) involved pairing individuals with similar features together before they were randomly assigned to the control and intervention groups (Robson, 1999, p.93). There was a need to compensate for the lack of a purely randomised sample by including pre and post-tests instead of post-tests alone. The participants that were randomly selected for this study were included on the basis of parental consent. The sample was not selected purely by chance and some influences, related to the consent procedure, may have increased the risk of 'sampling error'. It was possible that between participator differences in ability may have coincided with the effects of the intervention treatment. By comparing the differences between abilities in different sectors of the randomised sample it was felt to be possible to isolate any intervention effect as one located among a particular ability range in the sample. This could be achieved by using the pre-test measures as a baseline for dividing the sample into ability bands and then comparing the progress of particular subsections of the sample. While this process illustrated a third justification of the 'before and after' model in this experimental design, this practice is properly described as part of the process of statistical analysis.

3.3.3 Identifying strengths and limitations of the mixed design

The strength of a 'repeated measures' design is to avoid individual differences between participants masking the treatment effects. In 'repeated measures' designs the participants have more than one involvement in the design. The pre-test and post-test differences are available as data both for individuals as well as for the group as a whole. This option to take individual differences into account is helpful for assessing the effectiveness of the treatment with a degree of enhanced sensitivity which also strengthens construct validity.

The strength of a matched pairs design is that a 'matching variable' (such as between 'matched pairs' differences in measured reading behaviour) correlates highly with the 'dependent variable' (demonstrated as within individual differences in measured reading behaviour) so that individual differences between participants masking treatment effects are likely to be avoided. The 'predictor criterion validity' of the design is increased because the differences between individuals have been greatly reduced; any individual differences between the pairs at the post-testing stage are most likely to represent the effect of the intervention. The 'dependent variable' is projected, in such circumstances, more clearly as the product of the intervention treatment rather than as a less clear projection of a variety of masking factors. The 'matched pairs' design may also be used as an alternative to randomised sampling, but it is important that the researcher establishes that the conditions in which the groups are treated are the same and that the groups themselves are internally similar. In this investigation the 'matched pairs' design was used as a supplement to random sampling for increased reliability.

Criticism, levelled at experimental designs claims that,

> 'effects may be more subtle or difficult to conceptualise than researchers allow for' (Scott and Usher, 2000, p.64).

Having previously engaged with the music intervention in my own teaching practice sufficiently to appreciate the subtleties of any effects that were measured, I was aware that the absence of an explicit measure of fluency in reading would be problematic in my research design. Indeed, Scott and Usher (ibid.) do refer to the short-comings of standardised reading ability tests as blunt tools in the infinitely subtle processes of reading behaviour. While the Neale Analysis of Reading Ability (1989) is capable of providing data to infer whether fluency in reading has been influenced by the music intervention, this evidence has been supplemented by a measure of reading fluency that was developed during this research project (see Chapter 7 and Appendix X). In some experimental designs, Scott and Usher (ibid.) explain that there is not enough time for an intervention effect to transpire. Having used the intervention treatment in my teaching practice, I estimated that six weeks was a sufficient period for an effect to have taken place in the majority of children; nevertheless, more time was required for one sample and the experimental design was modified to afford more exposure to the intervention in this case (Chapter 5, section 5.3.10).

A third main criticism by Scott and Usher (2000, p.64) indicated that the context in which the participants exist and the context of data collection is very important and cannot easily be replicated thus producing an external validity problem. The participants in this investigation were tested in the typical school environment where experimental realism was maintained during the data collection process. Ecological validity, which is closely associated with the replicability of the research, is a contributory factor to the resilience of my research design. The issue of experimental realism is discussed by Aronson & Carlsmith (1986, cited in Robson 1999, p.81). They described an experiment as realistic if the situation that is presented to the participant is realistic. These writers also expressed concern for the degree of involvement that the participants experience and also the degree with which the study may impact upon them. In the intervention treatment of this particular study, it was essential that the participants engaged vigorously in the activity of stamping, clapping and chanting. The counterpart to 'experimental realism' is 'mundane realism' (Asch, 1956, p.81) where the experimental conditions are far removed from the real world. It would be reasonable for some critics to accuse me of 'mundane realism' as synchronised stamping, clapping and chanting is for many children in the sedentary world of the 21st century far removed from their experience of the real world. I argue that such activities may have an 'a priori' type of effect, hypothetically reintegrating us as humans not only, within ourselves at a basic, and fundamental temporal level, but also with our phylogenic selves and with each other in a culturally binding manner.

A fourth criticism by Scott and Usher (2000, p.66) centres on whether ethically, one group can be given a beneficial treatment while another group is denied that treatment for no reason apart from the constitution of the experimental design. It was ethically acceptable and appropriate for the researcher to revisit the school and to offer the intervention activity to the children that had not participated. Problems with school curriculum pressures and ethical accountability made it difficult to justify removing the control group from an academic lesson simply to give them 'attention', (and therefore avoid the so called 'Hawthorn Effect') while providing an activity that may be less useful to them than their usual academic lesson.

3.3.4 Measures

Since a test of fluency in reading was not available, a reading measure in which reading accuracy was not conflated with reading speed and which also measured reading comprehension was selected. An improvement in reading fluency has been argued to relate to an improvement in reading comprehension (Schreiber, 1980). Any organisational improvements at the interface between syntactic awareness and semantic awareness are likely to be defined as improvements in segmentation, appropriateness in rhythmic stress and appropriateness of rhythmic expression of the text. These three elements are identifiable factors in reading fluency, but at present a direct form of corresponding measurement does not exist. It was therefore necessary to infer that these factors may have contributed to any improvement in comprehension scores following the intervention treatment.

The Neale Analysis of Reading Ability

The Neale Analysis of Reading Ability Revised Edition (Neale, 1989) was designed for use with 6-13 year old children in Britain. The test is available in three parallel forms, two of which are standardised. The standardised procedure for conducting the test is clearly outlined in the manual and also on a cassette tape. There are six levels of difficulty in each of the parallel forms. The test measures the ability of the child to read aloud and their comprehension of the text. The tester is required to correct a word if it is read incorrectly by the child. In this way the oral understanding of the passage may be maintained despite the child's mistake. The tester is not required to prompt the child unless the thread of the story is likely to be lost due to lengthy hesitation (about six seconds). Above all, the tester is expected to avoid interfering with the natural fluency of the child's reading. A table summarising standardised scores and reliability of the Neale Analysis of Reading (Revised) is provided in Appendix I. There are three methods of scoring: reading accuracy, rate of reading, and reading comprehension. A reading accuracy score is achieved by miscue analysis through which omissions, reversals, additions, deletions and mispronunciations of words are recorded. A rate of reading score is measured as words per minute. Comprehension questions, including questions requiring the child to draw inferences from the text are posed immediately after the text has been read and the children are able to refer to the text while they answer the questions. In this way, any variability in working memory to *recall* the text (rather than any variability in working memory in the uptake of text) within the sample group is not likely to affect this study. The Neale Analysis of Reading Ability, Revised (Neale, 1989) measures accuracy of reading, rate of reading and reading comprehension. While these categories do not directly correspond with the 'timing' issues raised in the aims of the experiment, a comprehensive measurement of reading ability is provided by this measure. The interface that might develop between any effect of 'temporal regulation' and the measurements yielded by the Neale Analysis might offer some interesting insights into both reading behaviour and the theoretical construct of 'temporal integration'. The issue of construct validity between 'temporal integration' and the Neale Analysis of Reading Ability constituted an important exploratory facet of the experimental sequence.

Analysis of Reading Fluency

During the recording of the reading behaviour of the participants in the Three Field Experiments, it was observed that distinctly separate from the process of phonemic decoding, qualities of timing and phrasing contributed to reading behaviour. These observations led to the development of a reading fluency measure for this project. Word attack skills and word recognition are not measured by the 'Analysis of Reading Fluency'. Instead, this assessment measure records the appropriate placing of pauses, delineation of sentences, phrasing, rhythmic features and expressive content of reading. The development of the 'Analysis of Reading Fluency' included criteria that have been used to described fluent reading by researchers writing in the field of literacy development. In addition the internal organisational rhythmic structures that are identified by a number of theorists in the field of linguistics have been incorporated into the assessment. The 'Analysis of Reading Fluency' was developed so that each sentence read could be measured independently. This allowed for semantic or syntactic disorganisation in an isolated sentence to be registered as an independent event within the overall reading. The assessment is made by working from a digital recording of the reading sample. There are no established criteria for internal validity or reliability. The development and use of this measure is described in Chapter Seven and the pilot study is described in Appendix X.

Assessment of Rhythmic Discrimination

While temporal aspects of reading are not conveniently measured at present, standardised tests that measure the temporal aspects of music are available in the form of tests of rhythmic discrimination as one element in a battery of musical aptitude tests. The musical aptitude tests that are currently available are, for example, Seashore, (1939); Bentley, (1966); Gordon, (1965) and Wing, (1968). In these tests, the researcher is able to evaluate listening skills divided into the musical components of pitch, rhythm, timbre and melody perception. The standardised rhythm discrimination test was selected from the Seashore Measures of Musical Talents (Seashore, Lewis, Saetveit, 1939). It consists of 30 pairs of rhythmic fragments, which the participants identify as 'the same' or 'different'. The 30 items become progressively more complex and subtle as the test unfolds. The norms were established in 1939 from schools and colleges in the U.S.A.. Norms for the Seashore Measures of Musical Talents are presented at three educational levels: Grades 4-5, Grades 6-8 and Grades 9-19. Tests of validity are summarised in Bienstock, (1942) and Lundin (1953). The reliability of the Seashore Measures of Musical Talents was estimated by means of internal consistency coefficients which are provided in Appendix II. The lowness of the coefficients emphasises the importance of interpreting scores in broad categories only. The Seashore test of rhythmic discrimination was selected partly because it offers 30 items of progressive difficulty, which require focused concentration to be maintained by the participant throughout the test. Some children lost the thread of the test quite early on (possibly indicating a lack of 'temporal integration'). A disadvantage of this test is that the answers are scored in a binary system as 'same' or 'different', which means that children who guess have a 50% chance of choosing the right answer but it is administered as a group test and therefore is quick and easy to administer. The use of group testing techniques can present reliability problems such as the increased opportunity on the part of the participants to misunderstand the instructions, to copy from each other, or to create distracting behaviour. These threats to reliability were counteracted by the researcher walking quietly and slowly around the classroom during the assessment, observing and monitoring the behaviour of the participants; an atmosphere of focus and concentration was maintained in this way.

Rhythmic Performance

Learning disabled readers have been shown in three separate studies to be able to discriminate rhythm patterns similarly to matched, normal achieving readers but to be unable to perform the same patterns (Atterbury, 1985; Atterbury, 1983). It was possible that any change in temporal organization following participation in the music intervention, might be recorded more clearly through a test of rhythmic performance rather than a test of rhythmic discrimination. For this reason, it was decided that an investigation of any effect on rhythmic performance would be considered during this research project. A 'clapping-in-time' test was devised to assess rhythmic performance for this intervention study. The music used for this test was a recording of 'Moreno O Ba Etelle', a lively chorus of the Gospel music genre with a strong metrical beat in a moderate tempo. The extract was taken from a recording by 'Holy Spirits Choir' of South Africa and may be described as authentic in style. Small groups of two or three participants were asked to clap in time with the 'strong beats' of the music and to join in as soon as possible. The participants were then asked to maintain their clapping independently of the others in the small group. Each participant's clapping performance was scored as displaying a 'strong' or a 'weak' sense of metrical pulse. To qualify as displaying a 'strong' sense of metrical pulse, it was necessary for the participant to maintain their clapping performance in time with the musical accompaniment but without the support of the others in the small group. Each of these measures was tested in a pilot study prior to the investigation.

Movement Control and Balance

The Movement ABC (Henderson & Sugden, 1992) examines various areas of motor development such as balance, dexterity, co-ordination and movement skills. The two items selected for this investigation involved balance skills and an opportunity to evaluate both gross and fine motor control. The 'two board balance' is essentially a wobble board; the tester assesses the length of time that the participant maintains their balance without falling off, or by steadying themselves, touching the floor with one foot. The 'cutting out an elephant' item requires the participant to cut around an elephant shape while remaining within a narrow double outline. These tests were included because it was possible that eye-tracking movements, may demonstrate a form of 'balance' behaviour along text or musical notation, perhaps contributing to reading fluency. It was possible that the music intervention, might impact upon, or confound the main dependent variable, 'temporal integration', via vestibular routes. Data for the reliability of the Movement ABC (Henderson & Sugden, 1992) is set out in Appendix III.

3.3.5 Ethical Framework

Usher (1996), (cited in Cohen, Manion & Morrison, 2000, p.34-35) regarded the emancipating aspects of educational research as potentially empowering for all the participants. The *participants* ultimately held the 'power' in an experimental research design as they may have legitimately refused to co-operate with the experimenter, particularly since the experimenter's only contact with the participants was through research i.e. not as a practitioner-researcher. Nevertheless, the adult-child dynamic of the researcher-participant relationship, accorded 'power' in the in the traditionally 'authoritarian' domain of the adult. The 'counterpoint' between these two power dynamics ranged from being scarcely noticeable to being an artful balance of tact, brisk efficiency and inventiveness. While the participants were involved in the research process, they may have experienced boredom, tiredness or distrust of the motives of the researcher.

Researchers adopting the 'normative' experimental model, while emphasising the need for the most stringent standards in validity and reliability, are open to being criticised of deception. Writers such as Guba & Lincoln (1989, p.121) argue passionately for the diversification of qualitative and quantitative approaches within the field of education and psychology. In education research, where the participants are children, curiosity is less inhibited than it is among adults. Questions such as 'why was I chosen?', 'why are we doing this?' may conceal real anxieties concerning issues of inadequacy and fear of the unknown. In this investigation, participants with lower self-esteem and lower academic ability seemed to be more vulnerable to scrutiny. Because of this, it was felt appropriate to adopt a reassuring but professional distance, which seemed to relax these individuals. The tester also stated an interest in both 'right *and* wrong answers'. The idea that not withholding the 'purpose of the research' from the participants threatened the reliability of the research does not apply in this case. The theory behind the research was explained in advance to reassure and to encourage the participants to 'do their best'.

The debriefing process in the case of this research required the investigator to help the participants to leave the experimental session feeling as much their normal selves as possible. There is scope for criticism here as Coolican (1994) remarks:

> 'the debriefing itself may have to involve a little more deception, as when children are told that they 'did very well' whatever the actual standard of their performance,' (Coolican, 1994, p.398).

In this instance, the standard of the child's performance was not as important as the effort they had made to 'do their best' which was more likely to effect both reliability of the measurements and the validity of the findings. By thanking all the participants, for their *'help and hard work'*, effort was rewarded and a sense of judgement upon the standard of that work was underplayed.

Part Four

3.4.1 Processes concerning data

During the investigation, the purpose of the pre-testing and post-testing sessions was to generate data that would be used to describe the outcome of the experiments, to validate or to invalidate the theoretical underpinnings of the study and to make inferences or generalisations to the target population on the basis of the effect of the study on the randomly selected sample. The issues of reliability and validity are critical at this stage because as the data is handled, there is a threat of contamination, inconsistency and bias. Awareness of these issues is described here with regard to the management of the experimental data and the safeguards that were taken to guard against threats to reliability and validity at each stage of data processing.

3.4.2 Planned data collection

The issues surrounding the process of data collection raise questions to do with reliability and experimenter bias. The process of data collection provides an opportunity for both 'observer effects' and 'subject effects'. Standardisation, during data collection of an experimental investigation, is essential to safeguard validity and reliability within the study. The method of data collection of all the scores of all the participants needs to be identical. This concept is described well by both Coolican and Robson:

> 'The ideal is that, for each common aspect of an experimental procedure, every participant has exactly the same experience,' Coolican (1994, p.57).

Fortunately a very tight time frame existed in which to conduct the pre-tests and post-tests; only minimal interaction with participants was possible. In individual administration of the reading assessment I repeated the same instructions to each participant and no extra communication was involved. In this way, the process was entirely business-like in each pre-test and post-test session. The participants too were helped by the tight time frame which provided a degree of security for them. They were coping with reading unfamiliar text to an unfamiliar person in the pre-testing sessions. In the post-testing sessions, the apprehension of the pre-testing situation was not so palpable but the scores of the post-tests did not reflect this change in any way.

> 'Many of the data that we collect are actually produced during the enquiry itself... We often have a very active hand, not only in what is collected, but in how it is collected. The actual numbers that we subject to analysis are very much framed by a process of choice and selection,' (Robson 1999, p.328).

This reference to 'choice and selection' suggests a degree of subjectivity that is not desirable in an experimental context. However, 'experimenter bias' and 'subject effects' are of concern in such a context. These issues have been discussed earlier.

The Neale Analysis is accompanied by a set procedure for administration and this was strictly adhered to with respect to prompting the child while reading. The procedure for asking comprehension questions and for collecting the raw scores was also standardised according to the procedure outlined in the manual. Due to the severe time restraints, only one school day was allocated for each data collection. For this reason, the number of texts read by each child was limited. Rather than following the instructions in the manual which state that each reader begins with the text for level one and proceeds through several texts until reaching one that is too difficult, each participant was asked to look through the booklet and to choose the text that they felt was not 'too easy and not too difficult for them to read'. In the majority of cases, the participants were able to choose the text at the appropriate level so that a degree of difficulty was experienced but they did not struggle with so many words that the text would have been incomprehensible. In some instances the participants selected a text that was too easy and a 'ceiling effect' was immediately created. These participants were asked to read the text set at the next level of difficulty. In other instances the participants selected a text that was too difficult. The text was always abandoned after the participant had struggled with the opening sentence. If the participant did not request to read an easier passage, they were asked if they 'might like to try an easier passage?' The readings were recorded onto mini-discs for later data collection as 'rate of reading', 'accuracy of reading' and 'reading comprehension' scores and for auditing purposes.

Rate of reading was collected by timing the reading, (in seconds) and following a simple mathematical formula:

$$\text{Rate of Reading in words per minute} = \frac{\text{number of words of text}}{\text{total number of seconds}} \times 60$$

Reading accuracy is measured through miscue analysis. This procedure required the investigator to listen carefully to the recorded reading and to keep a tally of the mispronunciations, substitutions, refusals, additions, omissions and reversals that the child made during their reading of the passage. The total number of errors was subtracted from the maximum accuracy score, which is 16 in levels 1-5 and 20 in level 6. Due to this discrepancy in the scale, the scores were converted to percentages for ease of comparison. A possible reason that level 6 is scored out of 20 is to avoid a 'floor' effect. A 'floor' effect did occur in the reading accuracy scores that were collected in these experiments so the data was, where necessary, scored as a negative score to accommodate this difficulty. The data was continuous and of a ratio scale.

Goodman, (2000, p.4) cautions against methods of miscue analysis since researchers have, in some studies, penalised reading in dialect or regional accents as mispronunciations. Such practice would clearly provide a threat to validity as dialect is unlikely to represent inaccurate reading behaviour but will represent regional differences in pronunciation. I needed to decide whether or not to penalise the habitual mispronunciation of the consonant digraph: 'th' as 'v' or as 'f' or as 'd'. I decided that there were between participant differences in the various standards of pronunciation of 'th' and that these differences would need to be registered throughout the study as reading inaccuracies.

For the collection of reading comprehension data, the participants were permitted to reference the text as they answered the questions. This was to avoid introducing a confounding variable of memory. The answers were recorded onto mini-disc for moderation purposes. The comprehension answers were marked according to the answers provided in the manual. In the case of inferential questions, where subjectivity on the interpretational demands of the researcher may have introduced 'experimenter error effects', the answers in the manual were adhered to even if the answer that the participant provided may have appeared to be adequate. This decision was taken on grounds of standardisation and to avoid 'experimenter error effects'. The standardised answers in the test manual were used as the only acceptable answers for this study.

The 'Rhythm Test' from the Seashore Measures of Musical Talents (ibid) was marked according to the answers provided in the manual. The marking system requires no subjectivity on the part of the researcher. The Seashore Measures of Musical Talents (ibid) yielded continuous data of a ratio scale. The Clap a Musical Pulse test was marked according to whether the child was able to maintain metrical clapping along with a song performed by a gospel choir. This was collected as categorical data.

3.4.3 Identifying variables

In previous sections, it was suggested that, the dependent variable, 'temporal organisation' was likely to manifest as improved reading fluency and that behavioural changes in rhythmic response may also indicate that 'temporal integration' has taken place. A reliable reading fluency assessment measure was not available in an empirical form but a composite analysis of change in reading rate, reading accuracy and reading comprehension scores was thought to be sensitive enough to provide detection of a change in reading fluency. Each of the test scores, described previously, provided various measures of each participant's reading behaviour and rhythmic behaviour before and after the intervention period. By subtracting the pre-test scores from the post-test scores, a 'change score' was established, enabling any effect that may have taken place during the intervention period to be identified. The 'change scores' considered:

- Change in reading comprehension
- Change in reading accuracy
- Change in rate of reading
- Change in rhythmic discrimination

Each of the 'change scores' inferred the state of the dependent variable, 'temporal organisation'. The independent variables were:

- The respective scores of the control and intervention groups which accounted for between group variation,
- The pre-test and post-test scores which accounted for within group variation,
- Each of the baseline measurements for rhythmic behaviours and reading behaviours that were analysed to account for within group variation in ability.

The same measurement scores in rhythm behaviour and reading behaviour were used and manipulated in different ways. For example, it was possible that between participant differences in reading comprehension may have masked any intervention effect. Within the intervention group, one cluster of participants may have had a very high change scores while another cluster of participants may have had a very low change scores. These change scores when averaged would demonstrate the dramatic improvement in one cluster of participants being reduced immediately by the minimal improvement in the other cluster. If a pattern of dramatic change scores might be observed among a particular ability sector, then an ability distinction can be made in the data to highlight a particular pattern. The scores of participant clusters were therefore viewed using ability thresholds to prevent possible intervention effects being masked through statistical processes.

3.4.4 Summary

The whole design of this research project is illustrated in Table 3.1 and Table 3.2. The standardised assessment measures that were used in the experiments were piloted for their pertinence and efficacy. During the pilot study, conducted with 11-12 years of age participants, the assessment measures had been comprehensively tested. The results of the pilot for this study indicated that the most appropriate 'matching variable' was the reading comprehension pre-test scores; gains in reading comprehension were more pronounced than gains in reading accuracy or rate of reading. A statistically significant effect was found in improved reading comprehension and improved rhythmic discrimination. The three field experiments, (Experiments 'A', 'B' and 'C') each one a 'mixed design', were conducted between September 2002 and June 2003, described in Chapter Four. In these three experiments the sample was randomly selected from the mainstream school population aged 9-10 years of age. As well as receiving reading and rhythmic discrimination assessments, the participants were assessed on movement control and balance. The participants in the three field experiments were matched as pairs according to scores in reading comprehension before they were randomly assigned to the intervention and control groups. Following Experiment 'A' the assessment of movement control and balance ceased for reasons described in Chapter Four, section 4.2.4. A ceiling effect threatened the reliability of the rhythmic discrimination scores, therefore in Experiments 'B' and 'C' the sample was selected from younger schoolchildren aged 8-9 years of age. During Experiments 'A' and 'B' the rhythmic discrimination scores were not observed to being commensurate with the rhythmic performance skills of the participants in the music intervention. For this reason, a test of rhythmic performance was devised for Experiment 'C'.

Following the first three experiments, the two contrasting multi-sensory treatments experiment (Experiment 'D') was conducted between October 2003 and February 2004;

this is set out in Chapter Five. The sample for experiment 'D' was drawn from a population experiencing difficulties with reading comprehension and concentration; this population was informed by the consistent findings in the three field experiments. Two contrasting treatments were used in experiment 'D' to avoid a 'placebo effect'. In this instance, the participants received phonological awareness training in contrast with the music intervention. The 'Analysis of Reading Fluency' was piloted in experiment 'D' and the development and piloting of this measure is referred to in Chapter Seven and detailed in Appendix X. The samples for the two school trials, conducted between September and December 2004, described in Chapter Six, were drawn from the lowest ability English group in each of the two schools that participated. The school staff conducted the music intervention and therefore safeguarded for 'experimenter effects' taking place during the intervention period. The collection and analysis of the data was audited to safeguard against experimenter bias. The outcome of the audit is described in Chapter Six (section 6.4). The data from the trial in two schools was assessed for reading fluency in the 'Analysis of Reading Fluency'; the outcomes are described in Chapter Seven (section 7.3).

The research questions for this investigation are:

Where pupils are experiencing difficulty with metre and reading fluency, can metrical stamping, clapping and chanting while reading notation lead to improvement in the temporal organisation of reading?

Which pupils in particular are most likely to benefit from this intervention treatment?

Table 3.1: A summary of the methodology for this research project.

Date	Experiment	Age & size of sample	Population characteristic	Neale reading abilities	Rhythmic discrimination	Movement control	Rhythmic performance	Reading fluency
May-June, 2002	Pilot study	11-12 n = 12	Mainstream School	✓	✓	✓		
Sept-Oct, 2002	A	9-10 n = 24	Mainstream School	✓	✓	✓		
Feb-Mar, 2003	B	8-9 n = 24	Mainstream School	✓	✓			
May-June, 2003	C	8-9 n = 25	Mainstream School	✓	✓		✓	
Oct, 2003-Feb, 2004	D	10-11 n = 12	Difficulties with reading comprehension, concentration	✓	✓			✓
Sept-Dec, 2004	E	9-10 n = 18	Lowest ability English set	✓				✓
Sept-Dec, 2004	F	10-11 n = 11	Lowest ability English set	✓				✓

Table 3.2: A timeline detailing stages of the investigation and the evolution of decisions concerning sampling and assessment

Dates	**Jan 2002**	**May June 2002**	**Oct Sept 2002**	**Feb Mar 2003**	**May July 2003**	**Oct Feb 2003-2004**	**Sept Dec 2004**		**Oct 2005**
Stages of Investigation	Literature Survey	Pilot Study	Three Field Experiments 'A'	'B'	'C'	Two Contrasting Treatments Experiment 'D'	Trial in Two Schools School 'E' &	School 'F'	Data Audit
Tests used		Reading Rhythm Balance	Reading Rhythm Balance	Reading Rhythm	Reading Rhythm Metre	Reading Phonics Reading Fluency (Pilot study)	Reading Reading Fluency		
Sample		n = 12 11 – 12 yrs	n = 24 9 – 10 yrs	n = 24 8 – 9 yrs	n = 25 8 – 9 yrs	n = 12 10 – 11 yrs	n = 18; 9 – 10 yrs;	n = 11 10 – 11 yrs	

Three field experiments

Chapter four

4.1 Introduction

This chapter, structured in three parts, describes a sequence of three exploratory field experiments 'A', 'B' and 'C'. Although the experimental design and the music intervention were to be replicated across the three experiments, it was intended that the method of each experiment would evolve, adapting slightly to accommodate the outcome of the preceding experiment. The aims of the exploratory experiments were to investigate whether any effect in reading behaviour occurred following participation in the music intervention as described in Chapter One (section 1.1.1), and to identify any population that might have benefited from participation. The standardised assessment measures used in these experiments had been piloted for their pertinence and efficacy. Each of the three experiments in this sequence, conducted within the period of one 'half-term' was arranged so that a break in continuity of music intervention sessions would be avoided. The same mixed experimental design involving both a 'between subjects' (an intervention and control group) independent variable and a 'within subjects' (repeated measures) independent variable was applied across the three experiments.

Part One

Experiment 'A'

4.2.1 Introduction

The music intervention had originally been incorporated into my instrumental teaching to assist pupils that had difficulties with a sense of metrical pulse or difficulties with reading notation with fluency. Previous teaching experiences described in Chapter One, informed the decision to randomly select the sample for Experiment 'A' from the entire 9-10 years of age cohort of the host school.

4.2.2 Method

Experiment 'A' was conducted over a six-week period between September and October 2002.

Participants

The 24 children participating in the project were 9 -10 year old pupils at a middle school in a regional urban area.

Selection

The school was selected and approached initially by the County Music Service. A background information leaflet was distributed to the school explaining the aims, methods and ethical considerations of the experimental design. Interest was expressed by the head-teacher; consent letters and information leaflets describing the aims, methods and ethical considerations were distributed to a random selection of children and their parents from the target year group. The responses from the consent letters indicated parental permission for the pupils to miss 20 minutes of lesson time during pre-testing and post-testing sessions. The pupils who did not return the permission slips were not included in the sample group. It is possible that, by including this necessary consent procedure in the selection process, the sample group were selected, to some extent, according to parental perceptions and support of the experiment.

Materials

The participants of the sample group were subjected to a British reading test, a rhythm discrimination test and a movement assessment. Twenty minutes were allocated to each participant for individual testing. The rhythmic discrimination test was administered to the sample as a group. Both the Neale Analysis of Reading Ability (Neale, 1989) and the Seashore Tests of Musical Measures (Seashore, Lewis, Saeveit, 1939) were used consistently during the research project and are discussed in Chapter Three (section 3.3.4). The Neale Analysis of Reading Ability and The Movement Assessment Battery for Children (Henderson & Sugden, 1992) were individually administered. The opportunity to assess overall physical control was felt to be important at this stage in the investigation because the presence of a significant deficit in motor control among the sample may have had implications for the effectiveness of the music intervention under investigation in this study. These tests were also included in Experiment 'A' due to an interest in eye-tracking movements as a form of balance along text or musical notation perhaps contributing to reading fluency. It was possible that the music intervention might impact on the main dependent variable 'temporal integration', via vestibular routes.

The music notation used during the treatment sessions of the intervention period consisted of a selection of short pieces from 'Stepping Stones' (Colledge & Colledge, 1991) described in Chapter One (section 1.1.2).

Procedure

During the pre-tests, the participants' readings from the Neale Analysis were recorded onto audiocassette. Following the pre-tests, the participants were matched in pairs (See Appendix IV for matching data) according to their capability in rhythmic discrimination and reading comprehension. From each pair, each participant was randomly assigned to either the intervention group or the control group.

During the six-week intervention period, the control group participated in their normal class work while the intervention group participated in six weeks of music intervention sessions, each of 10 minutes duration. The music intervention sessions consisted of teaching the participants the activity of combined metrical stamping, clapping and chanting while reading musical notation.

The participants learned this activity in cumulative stages beginning with stamping 'in time' to a pre-recorded piano accompaniment. The group collectively felt and produced metrical impulses by stamping alternate feet. Cohesion between the participants helped them to entrain themselves metrically to the external timekeeper (the pre-recorded piano accompaniment). The stamping impulses became the foundation for assimilating the remainder of the activity. The participants then learned to coordinate clapping with their stamping. This was more difficult for some than others. When the majority of the group felt comfortable with the activity they were introduced to musical notation. Only two notes, a fifth apart, which afforded clear and easy visual distinction, were introduced at first and this introduction to notation was soon expanded to four notes. When the participants were confident that they could recognise and name the notes correctly, the activity of stamping, clapping and chanting while reading music began. The participants metrically stamped, clapped and chanted the names of the notes while keeping time with the recorded music. Each weekly intervention session proceeded in the same way. The participants were always taught to build their coordination upwards, beginning with stamping first. As the intervention group became more experienced with this activity, more complicated notation was introduced: two beat notes, rests and additional pitches to recognise and name. After the six-week intervention period, post-testing of both the intervention and the control groups was conducted. The participants' readings were recorded onto audiocassette.

Analysis

The data generated by the raw scores from the Movement ABC, Neale Analysis of Reading and the Seashore Rhythm Test were analysed using Multivariate Analysis of Variance on 'SPSS' software.

4.2.3 Results

Before the results were analysed, change scores were calculated by subtracting the pre-test score from the post-test score for each of the movement, rhythm and reading tests. The six variables of change in reading and rhythm were:

- Change in rhythmic discrimination
- Change in reading accuracy
- Change in rate of reading
- Change in reading comprehension
- Change in cutting out an elephant
- Change in two board balance

In the analysis, a comparison was made between the change scores of the music intervention group and the controls. This is summarised in Table 4.1. The table summarises a multivariate ANOVA in which six variables of change listed above were analysed for between participant effects.

Table 4.1: Summary of analysis of change between the music intervention group (Int) and controls (Ctrl) using a between subjects multivariate ANOVA.

Pre-tests and post-tests	Sample size		Mean Change		S.D.		df	Mean Change	S.D.	F	Sig
Group	**Int**	**Ctrl**	**Int**	**Ctrl**	**Int**	**Ctrl**		**Overall**			
Change in reading rate	12	12	24.08	20.33	10.51	9.57	1	22.20	10.02	.831	NS
Change in reading accuracy	12	12	28.63	14.56	31.57	24.32	1	21.59	28.48	1.50	NS
Change in reading comprehension	12	12	30.21	4.12	24.69	25.19	1	17.19	27.78	6.54	NS
Change in rhythmic discrimination	12	12	8.75	0.00	20.79	14.92	1	4.38	18.26	1.40	0.012
Change in cutting out an elephant	12	12	3.33	2.42	4.56	3.99	1	2.88	4.24	0.27	NS
Change in two board balance	12	12	-.92	.75	5.23	6.40	1	-.08	5.78	0.49	NS

Significant main effect

In the findings set out in Table 4.1, a significant main effect occurred between the control and intervention groups in the change in rhythmic discrimination measure. The mean changes were 8.75 for the intervention group and 0.00 for the control group. The change in rhythmic discrimination was found to be statistically significant, $p = 0.012$.

Introducing additional factors

According to the theory underpinning this investigation, the participants most likely to benefit from the treatment sessions during the intervention periods of these experiments were those with a weak sense of rhythm and metrical pulse and a lack of fluency in reading. To identify these participants, thresholds of ability were introduced into the analysis. In rhythmic discrimination, the threshold for above versus below 66% (the 24th percentile) ability was set to accommodate a ceiling effect that occurred in this measure. To identify the participants with below average capability in rhythmic discrimination and reading fluency, two additional factors were introduced which describe four additional groups:

- Above 66% score in rhythmic discrimination
- Below 66% score in rhythmic discrimination
- Above mean pre-test score in reading comprehension,
- Below mean pre-test score in reading comprehension.

These four groups were introduced into the analysis as two further factors in a multivariate ANOVA summarised in Table 4.2a and Table 4.2b. The table is presented in two parts to afford a larger font size. The first three of six dependent variables of change in reading rate, reading accuracy, reading comprehension, change in two board balance, change in cutting out an elephant reflect the outcome of the analysis are presented in Table 4.2a, the remainder are presented in Table 4.2b.

Of interest in this research are the analyses between the intervention participants and controls. For this reason, the only interactions that have been included in the tables are those that concern group interactions. Interactions between the dependent variables and the above/below ability groupings irrespective of the experimental conditions have not been included in the tables. No analysis was made by SPSS of the interaction between group x ability in reading comprehension x ability in rhythmic discrimination. There were no participants above average in reading comprehension but below the threshold in rhythmic discrimination in the intervention group.

Interactions between subgroups are labelled as:

* = group x ability in rhythmic discrimination

** = group x ability in reading comprehension.

Table 4.2a: Summary of a mixed design multivariate ANOVA between the factors of (i) experimental conditions, (ii) ability in reading comprehension, (iii) ability in rhythmic discrimination.

Pre-tests post-tests	Above v. below pre-test score		Sample size		Mean Change		Standard Deviation		df	Mean Change	S.D.	F	Sig.
	66% rhythm discri-mination	**Mean reading comp-rehension**	**Group**										
			Int	**Ctrl**	**Int**	**Ctrl**	**Int**	**Ctrl**		**Overall**			
Change in reading rate	**Above**	**Above**	5	4	25.59	24.75	3.68	8.35	1	25.22	5.76		
		Below	5	4	18.59	18.35	13.87	11.93	1	18.48	12.23		
		Total	10	8	22.09	21.55	10.25	10.13	1	21.85	9.90		
	Below	**Above**	-	2	-	18.25	-	10.25	1	18.25	10.25	1.764*	NS*
		Below	2	2	34.00	17.55	5.66	12.23	1	25.78	12.28		
		Total	2	4	34.00	17.90	5.66	9.22	1	23.27	11.25		
	Total	**Above**	5	6	25.59	22.58	3.68	8.61	1	23.95	6.70	.004**	NS**
		Below	7	6	22.99	18.08	13.79	10.74	1	20.73	12.23		
		Total	**12**	**12**	**24.08**	**20.33**	**10.51**	**9.57**	**1**	**22.20**	**10.02**	**1.888**	**NS**
Change in reading accuracy	**Above**	**Above**	5	4	38.78	-3.15	41.76	8.06	1	20.14	37.21		
		Below	5	4	26.16	15.58	25.13	8.17	1	21.46	19.29		
		Total	10	8	32.47	6.21	33.17	12.51	1	20.80	28.76		
	Below	**Above**	-	2	-	43.75	-	52.96	1	43.75	52.96	.353*	NS*
		Below	2	2	9.40	18.75	13.29	17.61	1	14.08	13.83		
		Total	2	4	9.40	31.25	13.29	35.31	1	23.97	30.18		
	Total	**Above**	5	6	38.78	12.48	41.76	34.45	1	24.44	38.47	1.407**	NS**
		Below	7	6	21.37	16.63	22.75	10.24	1	19.18	17.56		
		Total	**12**	**12**	**28.63**	**14.56**	**31.57**	**24.32**	**1**	**21.59**	**28.48**	**1.183**	**NS**
Change in reading compre-hension	**Above**	**Above**	5	4	15.00	3.12	10.46	15.73	1	9.72	13.66	19.440*	.000*
		Below	5	4	50.00	-6.25	26.56	7.22	1	25.00	35.36		
		Total	10	8	32.50	-1.56	26.48	12.39	1	17.36	27.16		
	Below	**Above**	-	2	-	-18.8	-	8.84	1	-18.75	8.84		
		Below	2	2	18.75	50.00	8.84	17.68	1	34.38	21.35		
		Total	2	4	18.75	15.63	8.84	41.30	1	16.67	32.27		
	Total	**Above**	5	6	15.00	-4.17	10.46	17.08	1	4.55	17.02	8.056**	.011**
		Below	7	6	41.07	12.50	26.73	30.62	1	27.88	31.10		
		Total	**12**	**12**	**30.21**	**4.12**	**24.69**	**25.19**	**1**	**17.19**	**27.78**	**0.180**	**NS**

Table 4.2b: Summary of a mixed design multivariate ANOVA between the factors of (i) experimental conditions, (ii) ability in reading comprehension, (iii) ability in rhythmic discrimination.

Pre-tests post-tests	Above v. below pre-test score		Sample size		Mean Change		Standard Deviation		df	Mean Change	S.D.	F	Sig.
	66% rhythm discri-mination	**Mean reading comp-rehension**	**Group**										
			Int	**Ctrl**	**Int**	**Ctrl**	**Int**	**Ctrl**		**Overall**			
Change in rhythmic discrimi-nation	**Above**	**Above**	5	4	1.00	-8.75	11.94	11.81	1	-3.33	12.25		
		Below	5	4	2.00	-5.00	14.40	12.91	1	- 1.11	13.41		
		Total	10	8	1.50	-6.87	12.48	11.63	1	-2.22	12.51		
	Below	**Above**	-	2	-	15.00	-	7.07	1	15.00	7.07	2.646*	NS*
		Below	2	2	45.00	12.50	14.14	17.68	1	28.75	22.87		
		Total	2	4	45.00	13.75	14.14	11.09	1	24.17	19.34		
	Total	**Above**	5	6	1.00	-0.83	11.94	15.63	1	0.00	13.41	.050**	NS**
		Below	7	6	14.29	0.83	24.74	15.63	1	8.08	21.36		
		Total	**12**	**12**	**8.75**	**0.00**	**20.79**	**14.92**	**1**	**4.38**	**18.26**	**7.904**	**.012**
Change in Cutting out an Elephant	**Above**	**Above**	5	4	4.60	2.50	1.14	5.32	1	3.67	3.54		
		Below	5	4	-0.20	2.75	4.76	3.77	1	1.11	4.37		
		Total	10	8	2.20	2.63	4.13	4.27	1	2.40	4.07		
	Below	**Above**	-	2	-	3.50	-	3.54	1	3.50	3.54	5.850*	.027*
		Below	2	2	9.00	0.50	1.41	4.95	1	4.75	5.74		
		Total	2	4	9.00	2.00	1.41	3.92	1	4.33	4.76		
	Total	**Above**	5	6	4.60	2.83	1.14	4.45	1	3.64	3.35	1.833**	NS**
		Below	7	6	2.43	2.00	5.97	3.85	1	2.23	4.90		
		Total	**12**	**12**	**3.33**	**2.42**	**4.56**	**3.99**	**1**	**2.88**	**4.24**	**3.448**	**NS**
Change in Two Board Balance	**Above**	**Above**	5	4	2.00	-3.50	3.39	7.00	1	-0.44	5.70		
		Below	5	4	-4.6	-1.00	5.81	1.41	1	-3.00	4.61		
		Total	10	8	-1.3	-2.25	5.68	4.86	1	-1.72	5.20		
	Below	**Above**	-	2	-	8.00	-	7.07	1	8.00	7.07	.024*	NS*
		Below	2	2	1.00	5.50	1.41	3.53	1	3.25	3.40		
		Total	2	4	1.00	6.75	1.41	4.79	1	4.83	4.79		
	Total	**Above**	5	6	2.00	0.33	3.39	8.64	1	1.09	6.53	3.923**	NS**
		Below	7	6	-3.0	1.17	5.51	3.87	1	-1.08	5.11		
		Total	**12**	**12**	**-.92**	**0.75**	**5.23**	**6.40**	**1**	**-0.08**	**5.78**	**.017**	**NS**

Significant main effect

In the findings set out in Table 4.2b, a significant main effect occurred between the control and intervention groups in the change in rhythmic discrimination measure. The mean changes were 8.75 for the intervention group and 0.00 for the control group. The change in rhythmic discrimination was found to be statistically significant, $p = 0.012$.

The significant main effect, in the experimental condition for the change in rhythmic discrimination scores was more pronounced for the participants in the intervention group attaining below 66% in the rhythmic discrimination pre-test scores. The mean change score of this group was higher than the mean change score of the group attaining above 66% in the rhythmic discrimination pre-test. The mean change scores in the rhythmic discrimination measure were 45.00 for the participants in the intervention group scoring below 66% in the rhythmic discrimination pre-test score (controls scored 13.75), and 1.50 for the participants in the intervention group scoring above 66% in the rhythmic discrimination pre-test scores (controls scored -6.87).

Significant interaction effects

There were three significant interaction effects in the between experimental condition for two of the four dependent variables.

(i) In the findings set out in Table 4.2a, a significant interaction effect occurred between the intervention and control groups and ability in rhythmic discrimination (above v. below 66% in the rhythmic discrimination pre-test score). This significant interaction effect was found to have occurred in the change in reading comprehension measure. The mean changes were 32.5 for the intervention group and -1.56 for the control group that had scored above 66% in the pre-test for rhythmic discrimination but were below the mean pre-test score in reading comprehension. The change in reading comprehension score between the factors of experimental conditions and ability in rhythmic discrimination was found to be highly statistically significant ($p = .000$).

(ii) In the findings set out in Table 4.2a, a significant interaction effect, between the control and intervention groups and ability in reading comprehension (above v. below mean ability in the reading comprehension pre-test score) was found in the change in reading comprehension measure. The mean changes were 41.07 in the intervention group and 12.5 in the control group. The change in reading comprehension score between the factors of experimental condition and ability in reading comprehension was found to be statistically significant ($p = 0.011$).

(iii) In the findings set out in Table 4.2b, a significant interaction effect for the change in cutting out an elephant measure occurred between the control and intervention groups and ability in rhythmic discrimination (above v. below 66% in the rhythmic discrimination pre-test). The mean changes were 9.0 in the intervention group and 2.0 in the control group for the participants that had scored below the ability thresholds in both rhythmic discrimination and reading comprehension pre-tests. The change in cutting out an elephant score between the factors of experimental conditions and ability in rhythmic discrimination was found to be statistically significant ($p = 0.027$).

4.2.4 Discussion Although this experiment was exploratory in nature, preliminary findings suggested that, for some children, participating in the music intervention was mainly associated with gains in reading comprehension scores and rhythmic discrimination, but not in reading accuracy, rate of reading, cutting out an elephant, or two board balance. In the rhythmic discrimination measure, the overall pre-test mean was 77.08 (Std D. 16.54); 100 was the highest possible score (see Appendix IV). This ceiling effect meant that some participants may have improved in rhythmic discrimination capability, but the ceiling effect would have prevented demonstration of any gains by some participants. A significant main effect in the change scores in the rhythmic discrimination measure was found between the control and intervention groups when contrasts in ability in the rhythmic discrimination pre-tests and in reading comprehension pre-tests were included as additional factors in the analysis thereby increasing the external validity of the experiment. The analysis in Table 4.2 is therefore more salient than the analysis in Table 4.1. The significant main effect for the change in rhythmic discrimination measure is more pronounced for the participants in the intervention group attaining below 66% in the rhythmic discrimination pre-test scores. For this group, the mean change score in the change in rhythmic discrimination measure was higher than the mean change score of the group attaining above 66% in the rhythmic discrimination pre-test. The mean change scores in the rhythmic discrimination measure were 45.0 for the participants in the intervention group scoring below 66% in the rhythmic discrimination pre-test score and 1.5 for the participants in the intervention group scoring above 66% in the rhythmic discrimination pre-test score. The sector of the intervention group sample that had achieved below average ability in the reading comprehension pre-test but were found to be above the 24th percentile in the standardised rhythmic discrimination pre-test score were found to have a greater increase in change scores in the reading comprehension measure than other members of the intervention group (and than others of commensurate abilities in the control group).

Two significant interaction effects were found between the experimental groups when contrasts in ability in the rhythmic discrimination pre-tests and contrasts in ability in reading comprehension pre-tests were included as factors in the analysis. The significant interaction effect in the change in reading comprehension measure, suggested a link between rhythmic discrimination and reading comprehension to be explored further. The largest differences between the control and intervention group were to be found in the children scoring above 66% in the rhythmic discrimination pre-tests (above the 24^{th} percentile). Although the addition of extra grouping variables yielded very small sample sizes therefore reducing the reliability of the statistical significances, further investigation into a relationship between ability in rhythmic discrimination and ability in reading comprehension following participation in the music intervention was indicated.

The significant interaction effect for the intervention group in the change in cutting out an elephant measure suggested that following participation in the intervention activity gains in scores had occurred for some participants in the intervention group. The children that had achieved below average scores in the reading comprehension pre-test and were found to be below the 24^{th} percentile in the standardised rhythmic discrimination pre-test score were found to have a greater increase in change scores for the 'cutting out an elephant' measure than others in the intervention group (and more than the participants of commensurate ability in the control group).

There were no significant findings in the 'two board balance' test from the 'Movement ABC'. The change scores were minimal in both the intervention and control groups. The minimal mean change scores for the 'two board balance' measure suggested an optimal level for 'experimenter effects' or 'demand characteristics' for Experiment 'A'. Two significant interaction effects for the intervention group were found in the change in reading comprehension measure when contrasts in ability in the reading comprehension and the rhythmic discrimination pre-tests were included as factors in the analysis. Both these significant interaction effects suggested that following the music intervention gains in reading comprehension scores occurred for the sector of the intervention group that were below the mean score in the reading comprehension pre-test scores.

From the random sample taken of the 9-10 years old cohort findings from this exploratory experiment suggested that following participation in the music intervention participants that had sustained gains in the reading comprehension measure had previously scored above the 24th percentile in rhythmic discrimination or had scored below the mean score in the reading comprehension pre-tests. Findings also suggested that the participants that demonstrated gains in improved rhythmic discrimination and 'cutting out an elephant' measures had scored below the 24th percentile in rhythmic discrimination or had scored below the mean score in the reading comprehension pre-test.

The suitability of the Neale Analysis of Reading Ability, Revised (Neale, 1989) as a means of assessing the abstract constructs of 'temporal regulation' and 'temporal integration' was initially an area of concern. These preliminary empirical findings suggested that following participation in the music intervention, there was change in reading comprehension for some children, particularly those who had below mean ability in reading comprehension at the time of pre-testing. Gains were also found in rhythmic discrimination scores following participation in the music intervention for the same group of children. These findings suggested possible links associated with the theoretical constructs of 'temporal regulation' and 'temporal integration'. Construct validity may be strengthened by this finding.

The random sampling of the whole 9-10 years old cohort appeared to have yielded a number of participants in the intervention group that benefited from the music intervention. Few participants appeared to score below the 24th percentile in the 'Rhythm Test' of the Seashore Measures of Musical Talents (Seashore, Lewis, Saetveit, 1939). This may be attributed to a 'ceiling effect' in the measure of rhythmic discrimination. The findings of this experiment appear to support some of the observations described in Chapter One (section 1.2), that difficulties regarding fluency in reading behaviour might be associated with difficulties regarding rhythmic behaviour and that the music intervention might be helpful for some pupils that experience difficulties in rhythm and reading.

Part Two

4.3 Experiment 'B'

4.3.1 Introduction

Following the outcomes of Experiment 'A' the experimental procedures were reviewed. The music intervention procedure was retained as it worked sufficiently well under 'experimental' conditions; the 'effect' observed while teaching, appeared unchanged by the non-teaching context.

An additional concern was the age of the sample population. Although the 9-10 year old cohort of the sample in Experiment 'A' matched the age of the original group for whom the teaching strategy was initially developed, concern that the validity of the investigation had been slightly threatened by the presence of a ceiling effect in the rhythm discrimination measure was recorded. For this reason, it was decided that a 8-9 years of age cohort in Experiment 'B' would be targeted in an effort to minimise a continuation of the ceiling effect in the 'Rhythm Test' in the Seashore Measures of Musical Talents (Seashore, Lewis, Saetveit, 1939).

Two measures: 'two board balance' and 'cutting out an elephant' (Henderson & Sugden, 1992) were removed from the investigation. In the findings of Experiment 'A' a significant interaction effect was found in the 'change in cutting out an elephant' measure. This finding, which may have been of interest in a study about coordination and motor control, did not contribute to the central focus of 'timing'. The original reason for including the two balance items (Henderson & Sugden, 1992) had been to screen the participants for severe movement difficulties. A further justification for excluding these items in future experiments in the sequence was that for the purposes of analysis, a smaller number of dependent variables is preferable as this minimises the unnecessary potential for Type I Error (a false positive finding) in the calculations of the multivariate analysis.

4.3.2 Method

Experiment 'B' was conducted during a six-week period between February and April 2003

Participants

The 24 children participating in Experiment 'B' were 8-9 years old pupils at a Junior Mixed Infant school in a regional market town.

Selection

The school was selected and approached initially by the County Music Service. A background information leaflet was distributed to the school explaining the aims, methods and ethical considerations of the experimental design. Consistent with Experiment 'A', the same method of random selection within the parameter of parental consent applied. A virus swept through the school during the week of the post-testing sessions and the sample was consequently reduced to 20 for this reason. The experimental mortality that was sustained in Experiment 'B' did not confound the effects of the experimental variables or bias the sample.

Materials

The participants of the sample group were administered the same British reading test (Neale, 1989) and rhythmic discrimination test (Seashore, Lewis, Saeveit, 1939) that were used previously in Experiment 'A'. During the intervention sessions, the same music notation resource 'Stepping Stones' (Colledge & Colledge. 1991) that had been used in the previous experiment was used.

Procedure

During the pre-tests, the participants' readings from the Neale Analysis were recorded onto mini-disc using a lapel microphone. The comprehension scores and the scores from the rhythmic discrimination test were assessed and the participants were organised into 'matched pairs' (see Appendix IV) to ensure that differences in ability and competence between the participants in each of the intervention and control groups were minimised.

The participants within each 'matched pair' were randomly assigned to either the control or the intervention groups. Consistent with Experiment 'A', the control group remained in their usual classroom activities while the intervention group participated in the music intervention for ten minutes every week. The six-week experimental period was identical in method to that of Experiment 'A'. Following the six-week music intervention, post-testing of both the intervention and the control groups was conducted. The participants' readings were recorded onto mini-disc using a lapel microphone.

Analysis

The data generated by the raw scores from both the Neale Analysis of Reading and the Seashore Rhythm Test were analysed using Multivariate Analysis of Variance on 'SPSS' software.

4.3.3 Results

The results were analysed by comparing the pre-test data with the corresponding post-test data. By subtracting the pre-test score from the post-test score for each of the rhythm and reading tests, four variables of change in reading and rhythm were calculated:

- Change in rhythmic discrimination
- Change in reading accuracy
- Change in rate of reading
- Change in reading comprehension

The changes that took place during the six-week intervention period in both the control and intervention groups were analysed using multivariate ANOVA and are summarised in Table 4.3.

Table 4.3: Summary of a mixed design multivariate ANOVA of change in the four dependent variables

Pre-tests and Post-tests	Sample size		Mean change		S. D.		df	Mean change	S.D.	F.	Sig.
Group	Int	Ctrl	Int	Ctrl	Int	Ctrl		Overall			
Change in reading rate	10	10	5.7	15.3	9.70	11.17	1	10.50	11.31	4.210	NS
Change in reading accuracy	10	10	2.00	2.10	2.54	3.00	1	2.05	2.70	0.006	NS
Change in reading comprehension	10	10	18.75	7.50	21.4	22.20	1	1.31	2.20	1.328	.012
Change in rhythmic discrimination	10	10	9.33	8.00	11.8	9.32	1	8.67	10.40	0.078	NS

Significant main effects

In Table 4.3, the findings of the mixed design multivariate ANOVA show a significant main effect between the experimental conditions (control v. intervention groups) in change in reading comprehension ($p = 0.012$). The mean changes were 18.75 for the music intervention group and 7.50 for the controls. No significant main effects were found in reading rate and reading accuracy measures from the Neale Analysis of Reading or in rhythmic discrimination from the Seashore measures of musical talents.

Introducing additional factors

Consistent with the analysis for Experiment 'A' and the theory underpinning this investigation, analyses were conducted taking account of participants with a weak sense of rhythm and metrical pulse and a lack of reading fluency. To identify these participants two additional factors were introduced[1] which describe four additional groups:

- Above 66% score in rhythmic discrimination
- Below 66% score in rhythmic discrimination
- Above mean pre-test score in reading accuracy
- Below mean pre-test score in reading accuracy.

The multivariate ANOVA is summarised in Table 4.4.

[1] Reading accuracy was found to indicate reading fluency in this sample. This change from reading comprehension in Experiment A to reading accuracy in Experiment B might be because of differing literacy pedagogy or sampling error.

Interactions between subgroups are labelled as:

* = group x ability in rhythmic discrimination

** = group x ability in reading accuracy

*** = group x ability in reading accuracy x ability in rhythmic discrimination.

Table 4.4: Summary of a mixed design multivariate ANOVA between the factors of (i) experimental conditions, (ii) ability in reading accuracy, (iii) ability in rhythmic discrimination.

Pre-tests & post-tests	Above v. below 66% rhythm discri-mination pre-test score	Above v. below reading accuracy mean pre-test score	Sample size		Mean Change		Standard Deviation		df	Mean Change	S.D.	F	Sig.
			Group										
			Int	**Ctrl**	**Int**	**Ctrl**	**Int**	**Ctrl**		**Overall**			
Change in reading rate	**Above**	**Above**	3	4	-2.33	18.25	10.41	12.63	1	9.43	12.63		
		Below	2	3	12.50	25.33	12.02	11.26	1	20.20	11.26		
		Total	5	7	3.60	21.29	12.50	12.80	1	13.92	12.80		
	Below	**Above**	2	2	13.00	-0.50	2.83	7.97	1	6.25	7.97	2.441***	NS***
		Below	3	1	4.33	5.00	6.35	5.20	1	4.50	5.20	10.869*	0.006*
		Total	5	3	7.80	1.33	6.69	6.30	1	5.38	6.30		
	Total	**Above**	5	6	3.80	12.00	11.26	10.84	1	8.27	10.84	0.209**	NS**
		Below	5	4	7.60	20.25	8.73	11.91	1	13.22	11.91		
		Total	**10**	**10**	**5.70**	**15.30**	**9.71**	**11.31**	**1**	**10.50**	**11.31**	**2.153**	**NS**
Change in reading accuracy	**Above**	**Above**	3	4	0.00	3.50	1.00	2.65	1	2.00	2.71		
		Below	2	3	4.00	2.00	5.66	4.58	1	2.80	4.44		
		Total	5	7	1.60	2.86	3.65	3.34	1	2.33	3.37		
	Below	**Above**	2	2	2.50	0.50	0.71	0.71	1	1.50	1.29	0.849***	NS***
		Below	3	1	2.33	1.50	1.15	-	1	1.75	1.50	1.082*	NS*
		Total	5	3	2.40	2.10	0.89	0.58	1	1.63	1.30		
	Total	**Above**	5	6	1.00	0.00	1.58	2.59	1	1.82	2.23	1.082**	NS**
		Below	5	4	3.00	4.00	3.08	3.87	1	2.33	3.32		
		Total	**10**	**10**	**2.00**	**2.10**	**2.54**	**3.00**	**1**	**2.05**	**2.70**	**0.255**	**NS**
Change in reading comprehension	**Above**	**Above**	3	4	8.33	6.25	7.22	16.14	1	7.14	12.20		
		Below	2	3	56.25	20.83	8.84	19.09	1	35.00	24.04		
		Total	5	7	27.50	12.50	27.10	17.68	1	18.75	21.45		
	Below	**Above**	2	2	6.25	12.50	8.84	17.68	1	9.38	11.97	0.701***	NS***
		Below	3	1	12.50	-37.5	12.50	-	1	0.00	27.00	0.052*	NS*
		Total	5	3	10.00	-4.17	10.46	31.46	1	4.69	19.97		
	Total	**Above**	5	6	7.50	8.33	6.85	15.14	1	7.95	11.56	10.719**	0.007**
		Below	5	4	30.00	6.25	25.92	33.07	1	19.44	30.05		
		Total	**10**	**10**	**18.75**	**7.50**	**21.44**	**22.20**	**1**	**13.13**	**22.02**	**8.817**	**0.012**
Change in rhythmic discrimination	**Above**	**Above**	3	4	1.11	10.83	5.09	9.95	1	6.67	9.23		
		Below	2	3	-3.34	4.44	9.23	3.85	1	1.33	6.91		
		Total	5	7	-0.67	8.10	6.41	8.13	1	4.45	8.45		
	Below	**Above**	2	2	23.33	10.00	4.72	18.85	1	16.67	13.61	0.014***	NS***
		Below	3	1	16.67	3.33	3.33	-	1	13.33	7.20	7.199*	0.020*
		Total	5	3	19.33	7.78	4.94	13.88	1	15.00	10.23		
	Total	**Above**	5	6	10.00	10.56	12.91	11.43	1	10.30	11.49	0.014**	NS**
		Below	5	4	8.67	4.17	12.16	3.19	1	6.67	9.13		
		Total	**10**	**10**	**9.33**	**8.00**	**11.84**	**9.32**	**1**	**8.67**	**10.40**	**0.310**	**NS**

Significant main effect

In the analysis set out in Table 4.3., a significant main effect occurred between the control and intervention groups in the change in reading comprehension measure. The mean changes were 18.75 for the intervention group and 7.5 for the control group. The change in reading comprehension was found to be statistically significant ($p = 0.012$).

The significant main effect in the experimental conditions factor for the change in reading comprehension scores was more pronounced for the participants in the intervention group attaining below the mean score in the reading accuracy pre-test scores. The mean change score of this group in the change in reading comprehension measure was higher than the mean change score of the group attaining above the mean score in the reading accuracy pre-test. The mean change scores in the reading comprehension measure were 30.0 for the participants in the intervention group (6.25 for controls) scoring below the mean score in the reading accuracy pre-test score and 7.5 for the participants in the intervention group (8.33 for controls) scoring above the mean score in the reading accuracy pre-test scores.

Significant interaction effects

There were three significant interaction effects in the between experimental conditions factor for three of the four dependent variables. The reliability of these significances is reduced by the very small sizes resulting from the extra grouping variables.

(i) A significant interaction effect occurring between the intervention and control groups and ability in rhythmic discrimination (above v. below 66% in the rhythmic discrimination pre-test score) was found in the change in reading rate measure. The mean changes were 7.8 for the intervention group and 1.33 for the control group. The change in reading rate score between the factors of experimental conditions and ability in rhythmic discrimination was found to be highly statistically significant ($p = 0.006$).

(ii) A significant interaction effect occurred between the control and intervention groups and ability in reading accuracy (above v. below mean ability in the reading accuracy pre-test score) in the change in reading comprehension measure. The mean changes were 30.0 in the intervention group and 6.25 in the control group. The change in reading comprehension score between the factors of experimental conditions and ability in reading accuracy was found to be highly statistically significant ($p = 0.007$).

(iii) A significant interaction effect occurred between the control and intervention groups and ability in rhythmic discrimination (above v. below 66% in the rhythmic discrimination pre-test) in the change in rhythmic discrimination measure. The mean changes were 19.33 in the intervention group and 7.78 in the control group. The change in rhythmic discrimination score between the factors of experimental conditions and ability in rhythmic discrimination was found to be statistically significant ($p = 0.02$).

4.3.4 Discussion

The findings of Experiment 'B' suggested that following participation in the music intervention gains in reading comprehension scores particularly among children with below average reading capability occurred.

A significant main effect in the change in reading comprehension measure was found between the control and intervention groups when contrasts in ability in the rhythmic discrimination pre-tests and contrasts in ability in reading accuracy were included as factors in the analysis. This significant main effect suggested that following participation in the music intervention activity, greater gains in reading comprehension scores had occurred among a sector of participants in the intervention group than the commensurate sector in the control group. The sector of the sample that had achieved below average capability in the reading accuracy pre-test and were below the 24^{th} percentile in the standardised rhythmic discrimination pre-test score were found to have a greater increase in their change score in the reading comprehension measure than others in the intervention group (and more than others of commensurate ability in the control group).

Three significant interaction effects were found between the experimental groups when contrasts in ability in the rhythmic discrimination pre-tests and contrasts in ability in reading accuracy pre-tests were included as factors in the analysis.

A significant interaction effect for the control group in the change in reading rate measure showed that participants in the sample that scored above the 66% rhythmic discrimination pre-test threshold read more quickly than the participants in the sample that scored below 66% in the rhythmic discrimination pre-test. Overall, the participants read more quickly in the post-test than the pre-test; the increase in rate of reading being more pronounced in the control group than the intervention group.

The exception to this pattern occurred in sector of the sample that scored below 66% in the rhythmic discrimination pre-test score but above average ability for the group in reading accuracy. At the time of pre-testing, the participants of this profile might have been described as having a weak sense of 'timing' but above average ability in decoding skills. An increase in change scores in rate of reading was found in the intervention group and a decrease in change scores in rate of reading was found in the control group. Similarly, the participants that read more quickly, this time in the intervention group, scored less well in the change scores in reading comprehension than the participants in the control group of commensurate ability. The highly significant interaction effect between abilities in reading accuracy and rhythmic discrimination in the rate of reading change scores may suggest preliminary empirical evidence of a relationship between these factors.

A significant interaction effect was found for the intervention group in the reading comprehension measure. This highly significant interaction effect suggested that following the music intervention improved reading comprehension scores occurred among participants of the intervention group that were found to be below the mean score in the reading accuracy pre-test scores.

The third significant interaction effect was found in the change in rhythmic discrimination measure for the intervention group. Although the rhythmic discrimination pre-test scores of this age group were fairly high, none of the participants reached the highest possible score in the post-tests. This finding showed that following the intervention activity participants in the intervention group with below 66% rhythmic discrimination pre-test scores appeared to have benefited more than the participants from the intervention group that achieved higher than 66% rhythmic discrimination scores in the pre-tests. This finding supported the teaching observations described in Chapter One (section 1.1.2) that the music intervention may provide an effective method for improving rhythmic behaviour and perhaps an overall sense of 'timing'.

These preliminary findings suggested that among a random sample of an 8-9 years old cohort, the participants that showed greater benefit from the intervention treatment had scored below the 24^{th} percentile in rhythmic discrimination or had scored below the mean score in the reading accuracy pre-test. The improvements that occurred for these two sub-groups of the intervention group were gains in reading comprehension scores and rhythmic discrimination scores.

Part Three

4.4. Experiment 'C'

4.4.1 Introduction

Following the successful reduction of the ceiling effect in the rhythmic discrimination measure in the previous experiment, a decision was made to continue to target a 8-9 year old population for random sampling in Experiment 'C'. The method for Experiment 'C' was altered in one respect. An additional rhythm test was introduced to provide a measure of rhythmic performance. It had been noticed that one or two participants in the previous experiments had scored well in the rhythmic discrimination measure but demonstrated a weak sense of metrical pulse during the music intervention.

References in the psychology of music literature on temporal perception and temporal performance (Atterbury 1985, 1983) showed that learning-disabled children aged 7-9 years of age were less successful in rhythmic performance than rhythmic discrimination when compared with normal readers matched for intelligence age. The rhythmic assessments, devised by the author included three types of presentation of 10 rhythmic patterns: tapped patterns on a wood-block, melodic patterns on a piano, both wood-block tapped combined with vocal presentation of the patterns. The rhythm section of the Gordon Primary Measures of Music Audiation (1979) was also presented in Atterbury's study. The participants were asked to provide three types of response to the rhythmic stimuli: to indicate, by pointing, whether the pairs of rhythmic patterns were the same or different, to join in clapping the rhythmic pattern with the stimulus, to echo clap the rhythmic pattern after they had heard it. The Atterbury findings indicated support for findings in Experiment B, notably that for some children, ability in rhythmic discrimination did not appear to correlate strongly with competency in performance, i.e. the rhythm-based music intervention. This discrepancy might be described by a cognitive model of 'perception and production' of rhythmic patterns (Large and Jones, 1999, p.102). In dynamic attending theory, the perceiver or performer attends in oscillating cycles which results in peaks of attending that correspond with successive time points across time spans that separate metrical accents. Distinguishing between different types of attending process, Shiffrin describes pre-attentive processes as being,

> 'automatic, effortless, unconscious, and operate in parallel, while attentive ones are serially controlled, effortful and conscious....' (Shiffrin, 1988, cited Jones and Yee, 1993, p.73).

An interactive model explaining a possible dynamic between both parallel and serial forms of attending process might account for intra-individual variation between performance in tasks of rhythmic discrimination and rhythmic performance.

In Experiment 'C', a clapping test was introduced. Unlike, Atterbury (1983, 1985), performances of rhythmic patterns were not required, but the participants were asked to clap a metrical pulse in time with a musical stimulus. This test explored the ability of the participants to judge and predict the metre of the music and also to respond motorically, displaying temporal control, see Chapter Three (section 3.3.4).

4.4.2 Method

Experiment 'C' was conducted during a six-week period between May and July 2003.

Participants

The 25 children participating in this research project were 8-9 year old pupils at a Junior Mixed Infant School, in the same regional market town as the school that participated in Experiment 'B'.

Selection

The school was selected and approached initially by the County Music Service. The selection process that has been described in Experiment 'A' was repeated in Experiment 'B' and also Experiment 'C'. This procedure involved random selection subject to parental consent.

Materials

The sample group of Experiment 'C' were subjected to the same British reading test (Neale, 1989) and rhythm discrimination test (Seashore, Lewis, Saetveit, 1939) that were used previously in experiments 'A' and 'B'. In Experiment 'C' an additional test, 'Clapping in time' was introduced to investigate the effect of rhythmic performance on 'temporal integration' and reading fluency. The music used for this test was a recording of a lively chorus of the Gospel music genre with a strong metrical beat in a moderate tempo. The extract was recorded by 'The Holy Spirits Choir' of South Africa and may be described as authentic in style. Small groups of two or three participants were asked to clap in time with the 'strong beats' of the music and to join in as soon as possible. The participants were then asked to maintain their clapping independently of the others in the small group. Each participant's clapping performance was scored as displaying a 'strong' or a 'weak' sense of metrical pulse. To qualify as displaying a 'strong' sense of metrical pulse, it was necessary for the participant to maintain their clapping performance in time with the musical accompaniment but without the support of the others in the small group. During the intervention sessions, the same music notation resource 'Stepping Stones' (Colledge & Colledge, 1991) that had been employed in the previous experiments was used.

Procedure

During the pre-tests, the participants' readings from the Neale Analysis were recorded onto mini-disc. The comprehension scores and the scores from the rhythmic discrimination test were assessed and the sample was divided into two groups according to the 'matched pairs' principle. Before the participants were randomly assigned to either the intervention group or the control group they were matched into pairs according to capability in rhythmic discrimination and reading comprehension; differences in ability between the participants of the intervention and control groups were minimised (see Appendix IV). During the six-week intervention period, the control group participated in their normal class work while the music intervention group participated in a weekly treatment session of 10 minutes duration. The control group participated in small group activities involving either computer work or musical sessions with a visiting music specialist.

The procedure used for directing the music intervention replicated the sessions in Experiment 'A' and Experiment 'B'. Identical instructions were provided; the same pre-recorded musical accompaniment was used to ensure that speeds were consistent across the three experiments. After the six-week intervention period, post-testing of both the intervention and the control groups was conducted. A parallel form of the Neale Analysis of Reading was used to control for long-term memory of the pre-test material. The participants' readings were recorded onto mini-disc.

Analysis

The data generated by the raw scores from the Neale Analysis of Reading, the Seashore Rhythm Test and the test of rhythmic performance were analysed using Multivariate Analysis of Variance on 'SPSS' software. The participants' readings, recorded onto mini-disc from both the pre-test and post-test sessions, were preserved.

4.4.3 Results

The results were analysed by comparing the pre-test data with the corresponding post-test data of each experiment. By subtracting the pre-test score from the post-test score for each of the rhythm and reading tests, four variables of change in reading and rhythm were calculated:

- Change in rhythmic discrimination
- Change in reading accuracy

- Change in rate of reading
- Change in reading comprehension

The changes that took place during the six week intervention period in both the control and intervention groups of Experiment 'C' are summarised in Table 4.5.

Table 4.5: Summary of analysis of change between the music intervention group (Int) and controls (Ctrl) using a between subjects multivariate ANOVA.

Pre-tests and Post-tests	Sample size		Mean change		S. D.		Mean change	S.D.	df	F	Sig.
Group	Int	Ctrl	Int	Ctrl	Int	Ctrl	Overall				
Change in reading rate	13	12	0.37	-6.0	13.27	16.24	14.82	-2.68	1	1.162	NS
Change in reading accuracy	13	12	9.62	0.76	21.01	36.70	5.37	29.30	1	0.560	NS
Change in reading comprehension	13	12	21.15	-1.04	35.86	19.55	10.50	30.76	1	3.600	.006
Change in rhythmic discrimination	13	12	6.92	11.92	16.53	12.14	9.31	14.51	1	0.731	NS

Significant main effects

In Table 4.5, the findings of the mixed design multivariate ANOVA show that a significant main effect occurred in the between experimental condition factor (control v. intervention groups) in the change in reading comprehension measure. The mean changes were 21.15 for the intervention group, -1.04 for the control group, and 10.50 overall. The effect was highly significant $p = 0.006$. No significant main effect was found for reading rate and reading accuracy measures from the Neale Analysis of Reading or in rhythmic discrimination from the Seashore measures of musical talents.

According to the theory underpinning this investigation, the participants that were most likely to benefit from the treatment sessions during intervention periods were those with a weak metrical pulse and below average capability in reading fluency. The Neale Analysis of Reading Ability does not measure reading fluency specifically and the 'Rhythm Test' from the Seashore battery measures rhythmic discrimination rather than rhythmic performance. However, a clapping test of rhythmic performance was developed for this experiment to test the presence of a weak metrical pulse. To identify the participants with lower than average reading capability, and a weak metrical pulse, two additional factors were introduced which describe four additional groups:

- Strong metrical pulse,
- Weak metrical pulse,
- Above mean pre-test score in reading comprehension,
- Below mean pre-test score in reading comprehension.

These four groups were introduced into the analysis as two further factors in a multivariate ANOVA summarised in Table 4.6.

Interactions between subgroups are labelled as:

* = group x ability in rhythmic metrical pulse

** = group x ability in reading comprehension

*** = group x ability in reading comprehension x ability in rhythmic metrical pulse

Table 4.6: Summary of a mixed design multivariate ANOVA between the factors of (i) experimental conditions, (ii) ability in reading comprehension, (iii) ability in rhythmic performance.

Pre-tests and post-tests	Above v below mean reading compre-hension pre-test score	Strong v. weak metrical pulse pre-test score	Sample size		Mean Change		Standard Deviation		df	Mean Change	S.D.	F	Sig.
			Group										
			Int	**Ctrl**	**Int**	**Ctrl**	**Int**	**Ctrl**	**Overall**				
Change in reading rate	**Above**	**Weak**	3	1	5.10	0.21	3.82	-	1	3.88	3.96		
		Strong	5	4	-2.73	-17.4	20.56	19.93	1	-9.24	20.49		
		Total	8	5	0.21	-13..9	16.19	18.97	1	-5.20	17.99		
	Below	**Weak**	1	4	12.98	-7.3	-	12.41	1	-3.22	14.06	2.286***	NS***
		Strong	4	3	-2.46	8.77	5.42	3.96	1	2.36	7.48	0.148**	NS**
		Total	5	7	0.63	-.40	8.35	12.48	1	0.03	10.52		
	Total	**Weak**	4	5	7.07	-5.8	5.03	11.26	1	-0.07	10.89	0.634*	NS*
		Strong	9	7	-2.61	-6.2	14.91	19.98	1	-4.16	16.78		
		Total	**13**	**12**	**0.37**	**-6.0**	**13.27**	**16.24**	**1**	**-2.69**	**14.82**	**1.096**	NS
Change in reading accuracy	**Above**	**Weak**	3	1	8.33	-68.8	17.56	-	1	-10.94	41.12		
		Strong	5	4	2.02	11.67	8.82	19.85	1	6.31	14.58		
		Total	8	5	4.39	-4.5	11.97	39.86	1	1.00	25.16		
	Below	**Weak**	1	4	37.50	-3.5	-	46.07	1	4.75	43.90	0.697***	NS***
		Strong	4	3	13.13	15.00	32.92	25.37	1	13.93	27.52	0.291**	NS**
		Total	5	7	18.00	4.46	30.52	37.05	1	10.10	33.70		
	Total	**Weak**	4	5	15.63	-16.5	20.45	49.45	1	-2.22	40.82	6.060*	.025*
		Strong	9	7	6.96	13.10	21.90	20.37	1	9.64	20.78		
		Total	**13**	**12**	**9.62**	**0.76**	**21.02**	**36.71**	**1**	**5.37**	**29.31**	**4.096**	NS
Change in reading compre-hension	**Above**	**Weak**	3	1	4.17	0.00	26.02	-	1	3.13	21.35		
		Strong	5	4	15.00	-21.9	33.54	18.75	1	-1.39	32.74		
		Total	8	5	10.94	-17.5	29.46	18.96	1	0.00	28.87		
	Below	**Weak**	1	4	100.00	12.50	-	10.21	1	30.00	40.12	5.553***	.031***
		Strong	4	3	21.88	8.33	27.72	7.22	1	16.07	21.30		
		Total	5	7	37.50	10.71	42.39	8.63	1	21.87	29.74	1.757**	NS**
	Total	**Weak**	4	5	28.13	10.00	52.42	10.46	1	18.06	34.30	0.831*	NS*
		Strong	9	7	18.06	-8.93	29.39	21.30	1	6.25	28.87		
		Total	**13**	**12**	**21.15**	**-1.04**	**35.86**	**19.55**	**1**	**10.50**	**30.76**	**9.854**	**.006**
Change in rhythmic discrimin-ation	**Above**	**Weak**	3	1	6.67	26.67	20.00	-	1	11.67	19.15		
		Strong	5	4	2.66	12.50	5.96	8.77	1	7.04	8.57		
		Total	8	5	4.17	15.33	11.79	9.89	1	8.46	12.07		
	Below	**Weak**	1	4	-20.00	5.00	-	14.54	1	0.00	16.84	0.533***	NS***
		Strong	4	3	19.17	15.44	17.51	12.43	1	17.57	14.45	0.113**	NS**
		Total	5	7	11.33	9.48	23.17	13.72	1	10.25	17.29		
	Total	**Weak**	4	5	0.00	9.33	21.09	15.89	1	5.19	17.81	2.342*	NS*
		Strong	9	7	10.00	13.76	14.43	9.61	1	11.64	12.32		
		Total	**13**	**12**	**6.92**	**11.92**	**16.53**	**12.14**	**1**	**9.32**	**14.51**	**4.046**	NS

Significant interaction effects

There were two significant interaction effects in the between experimental conditions factor for two of the four dependent variables.

(i) In the findings set out in Table 4.6, a significant interaction effect between the experimental condition (between the intervention and control groups) and ability in rhythmic performance (weak v. strong in the rhythmic performance pre-test score) was found in the change in reading accuracy measure. The mean changes were 15.63 for the intervention group and -16.50 for the control group. The change in reading accuracy score between the experimental condition and controls and ability in rhythmic performance was found to be statistically significant ($p = 0.025$).

(ii) A significant interaction effect occurred between the experimental condition (between the control and intervention groups) and ability in reading comprehension (above v. below mean ability in the reading comprehension pre-test score) and ability in rhythmic performance (weak v. strong metrical pulse in the pre-test score) in the change in reading comprehension measure. The mean changes were 100.00 in the intervention group and 12.50 in the control group. The change in reading comprehension score between the factors of experimental condition, ability in reading comprehension and ability in rhythmic performance was found to be statistically significant ($p = 0.031$).

<u>4.4.4 Discussion</u>

In keeping with Experiments 'A' and 'B', the findings of Experiment 'C' suggested that the activity of metrically organised stamping, clapping and chanting while reading music notation was associated with improved comprehension scores particularly among the children with below average reading capability.

The highly significant main effect ($p = .006$) suggested that following participation in the intervention activity, gains in reading comprehension scores had occurred for the intervention group.

The significant interaction effects found in Experiment 'C' were in the change score in reading accuracy ($p = 0.025$) and in the change score in reading comprehension (p =

0.031). Both these findings suggested that following participation in the music intervention, children who had scored below average in reading comprehension and had also displayed a weak sense of metrical pulse in the pre-tests, demonstrated greater improvement in the change scores in reading comprehension and reading accuracy, than the participants that achieved above average scores in reading comprehension and had demonstrated a secure sense of metrical pulse in the pre-tests.

This experiment was the third of three exploratory experiments. These findings, consistent with Experiments 'A' and 'B', suggest that participation in the music intervention was associated with improved reading behaviour, particularly improved reading comprehension scores. Gains were found for children with below average reading comprehension scores and who demonstrated the presence of a weak metrical pulse before participating in the intervention treatment.

4.5 Summary

Although the experiments set out in this chapter were exploratory in nature, some patterns emerged from the findings. Following participation in the intervention treatment, statistically significant effects occurred in improved reading, particularly reading comprehension scores, and rhythmic behaviour across the three field experiments.

The random sampling of a whole 9-10 years old cohort and two 8-9 years old cohorts from three schools appears to have yielded a number of participants in each intervention group that benefited from the music intervention. These participants belonged to a population that scored below the 24th percentile in the 'Rhythm Test' of the Seashore Measures of Musical Talents (Seashore, Lewis, Saetveit, 1939) or demonstrated a weak sense of metrical pulse. Variation was found in the findings regarding a potential relationship between ability in rhythmic discrimination and gains in reading comprehension following participation in the music intervention. These variations may be attributed to sampling effects, due to differences in reading pedagogy or other factors.

The observations that were made as an instrumental music teacher, described in Chapter One, (section 1.1.2) were that difficulties regarding fluency in reading behaviour might be associated with rhythmic difficulties which centred around a weak sense of metrical pulse in the pupil. The stamping, clapping and chanting exercises, which were developed through music teaching to help pupils with a weak sense of metrical pulse to make progress in instrumental music, were replicated to provide the music intervention activity in these experiments. Although the experiments were exploratory and formed the preliminary stage of this project, the findings suggested that the music intervention was helpful for some participants. They confirmed the observations that were made in the instrumental music teaching studio: that stamping, clapping and chanting appeared to improve ability in reading and rhythm among a population with below average scores in reading and rhythm.

The relationship between the content of the Neale Analysis of Reading Ability, Revised (Neale 1989) as a general measure of reading ability, and the abstract constructs of 'temporal regulation' and 'temporal integration' under investigation in this research project have been considered. The empirical findings suggested that participation in the intervention may lead to changes in temporal organisation, which might arguably manifest as change in the reading comprehension item from the Neale Analysis of Reading Ability.

If an improved reading comprehension score is an indication of a degree of improved reading fluency, then according to the theoretical framework of this project, a form of temporal organisation may have occurred during the participation in the music intervention. The Neale Analysis of Reading (Neale, 1989) provided a somewhat blunt approximation of reading fluency which is inferred by the separate measures of reading accuracy, reading rate and reading comprehension.

For an effect to have occurred, the sectors of the intervention groups of each experiment that had been identified as scoring below the average in reading and / or rhythm ability tests were successfully engaged in the intervention activity. This involved the fluent reading of simple musical notation while stamping, clapping and chanting in time with the musical accompaniment. In the findings of the three exploratory experiments, improved reading comprehension scores among the participants of the intervention group with below average scores in reading comprehension, the presence of a weak metrical pulse or rhythmic discrimination below the 24^{th} percentile, appear to lend some indirect support to the hypothesis that the music intervention increases reading fluency among pupils that may have learning difficulties associated with a lack of temporal organisation.

Following these experiments, several questions have been raised,

- Is improved reading comprehension a possible indication of improved reading fluency?
- How might change in temporal organisation, brought about through the stamping, clapping and chanting activity, affect reading comprehension?
- Might any intervention effect be associated with improved uptake of information during reading of improved fluency?

Two contrasting multi-sensory treatments

Chapter five

5.1 Introduction

In Chapter Four, three field experiments were detailed, their aim, to establish whether participating in the music intervention strategy influenced reading behaviour. The findings from the three experiments suggested that the music intervention had a positive effect on reading behaviour for below average ability readers. The findings consistently indicated that the greatest gains were found in the change scores of reading comprehension. In Experiment 'A' the increased reading comprehension scores of the intervention group suggested that the music intervention can improve reading behaviour. In Experiments 'A' and 'B', the statistically significant increase in reading comprehension scores of the children with below average scores in reading accuracy or reading comprehension suggested support for the hypothesis that stamping, clapping and chanting may improve reading behaviour among children with below average capability reading behaviour. In Experiment 'C', a statistically significant increase in reading comprehension score was found for the children of the intervention group with a weak sense of metrical pulse in the pre-tests. The findings of these experiments consistently indicated that the music intervention had a beneficial effect on reading comprehension scores. This effect might have been achieved through improved temporal organisation.

Consequently, the exploratory aspect of this research project was satisfied at a preliminary level. It became possible and indeed necessary to reframe the research questions in a new way. A more refined and focused line of enquiry was sought and developed by asking, more specifically:

- How did the music intervention influence reading behaviour so that the change scores of reading comprehension improved?
- Given that the findings of the three preliminary experiments indicated that the children of below average reading ability benefited most from participating in the

music intervention, which particular cognitive features of these participants seemed to predispose them to benefit from the music intervention?

The present chapter focuses on 'timing' as an aspect of reading behaviour and aims to develop some understanding of 'timing' in reading processes. A brief review of literature was made to assist the refinement of the enquiry.

5.2 Mini-Review of Literature

5.2.1 Reading Comprehension Deficit

Many children demonstrate decoding skills and a level of fluency indicating that word recognition is working well. Nevertheless, Oakhill (1993, p.234) found that a significant proportion of children, not diagnosed as having a reading difficulty, may have a specific comprehension problem. Researchers collected evidence for this deficit (see Oakhill 1993). The children that comprehended poorly were recognised by Cromer (1970) as preferring to treat words as single units, failing to make use of the syntactic constraints in text, and tending to read word-by-word, rather than processing the text in meaningful units in spite of their adequate intelligence to do so. Oakhill (1993) showed that poor comprehenders experienced difficulties in integrating information in the text and in drawing inferences from the text. In several investigations Oakhill (1993,p.25) demonstrated that in spite of normal short-term memory capability, poor comprehenders experienced difficulties holding and manipulating information in working memory.

The 'bottleneck hypothesis' (Perfetti, 1985, cited in Oakhill, 1993, p.224) for poor comprehension, where a deficit in decoding at the single word level due to the reader's limited vocabulary or a deficit in automaticity of decoding consumes the attention or mental space leaving no capacity in the short-term memory for comprehension processes was described and challenged by Oakhill (1993, p.24-5). Findings failed to show that training in rapid decoding resulted in an improvement in comprehension (Oakhill, 1993, p.225). In agreement with Anderson (1992), Oakhill, (1993) proposed that the comprehension deficit lay in the inadequacy of the reader's background knowledge (or schema). An alternative, more complex explanation provided by Oakhill, described

> 'a difficulty in accessing the relevant knowledge and integrating it with the information in the text because of processing limitations (Oakhill, 1993, p.228).

This explanation which embraces tacit and abstract 'processing limitations' appears to acknowledge an integrating process operating between decoding and comprehension.

5.2.2 Fluent Reading and Reading Comprehension

Consideration of processes contributing to fluency may provide insight into processes that contribute to comprehension. Links between the role of reading fluency and reading comprehension, argued for by Schreiber (1980), have been difficult to establish according to Allington (1983, p.559). Difficulties have been attributed to a lack of an appropriate theory and speculative conclusions about the effects of instruction in oral reading. While a causal relationship remains to be demonstrated, oral fluency appears to be indirectly related to silent reading comprehension. A correlation found between various aspects of oral reading fluency and comprehension, has been cited by Allington (1983, p.559). Similarly, Schreiber stated that,

> 'a fluent reader decodes text automatically – that is, without attention – thus leaving attention free to be used for comprehension.' (Schreiber, 1980, p. 179)

Repeated reading, proposed by Samuels (1979) as a method for increasing reading fluency, was researched extensively between 1978 and 1985. In many of these studies children practised their reading independently and unassisted. However, Chomsky (1976) developed a tape-assisted procedure. Similarly, Morgan and Lyon (1979) examined repeated reading supported by a parent or student. These approaches were combined by Schneeberg, (1977) who developed a teacher plus tape-assisted approach, while Smith, (1979) directed a teacher led procedure. Various theories have underpinned the development of supported repeated reading strategies. These are 'whole language theory' (Clay, 1985; Holdaway 1979; Hoskisson 1975 a & b), 'automaticity theory' (Samuels 1979; LaBerge and Samuels, 1974), 'verbal efficiency theory' (Perfetti & Lesgold, 1979) and the 'theory of prosodic cue development', (Schreiber, 1980,1987; Herman, 1985). This summary of repeated reading is cited from Dowhower, (1987, p.390-391).

Reading comprehension, was found by Dowhower, (1987) to be positively affected by the 'supported repeated reading programme'; as children's reading rate, accuracy and comprehension increased they also improved in prosodic reading by using appropriate segmental lengthening and intonation at phrase markings. They no longer read in a word-by-word fashion and these improvements were carried over into new texts (Dowhower, 1987, p.402). To explain these findings, Dowhower referred to an earlier study by Schreiber (1980) who had claimed that repeated reading procedures,

> 'force beginning readers tacitly to recognize the syntactic structures or segments in the print that they already know and use in speech so that they read not word-by-word but in meaningful phrases', (Schreiber, 1980, p.183).

However, the effect of repeated reading on reading comprehension is generally not substantiated. Little support has been found (Dowhower, 1987, p.391) for claims that the 'repeated reading programme' helps children to understand practised material better. Contradictory findings have been reported by Dowhower (ibid) particularly regarding the transfer of gains in comprehension on practised text to increased understanding of new unpractised text. One of the implications of this study (Dowhower, 1987, p.404) was to identify a need for detailed exploration into the proposed relationship between prosody and reading comprehension.

5.2.3 From fluency to prosody

Further insight into the reading behaviour of children participating in a typical 'tape-assisted supported repeated reading programme' has been described by Carol Chomsky's (1976) analysis of a novice reader. She concluded that the novice reader had not achieved true reading but a combination of quasi-memorization and quasi-reading and that gains in reading fluency and reading comprehension may have been assimilated and integrated through temporal aspects of reading behaviour. The child in the description was described as able to 'read' unsupported and 'with expression' (Chomsky, 1976, p.290). The expressive voice, characteristic of a pre-reading stage described as 'memory reading', has been noted by researchers observing the behaviour of children who have been read to a great deal (Chomsky, 1976, p.289).

The rationale behind the repeated reading, tape-assisted, procedure is modeled on the concept of 'memory reading'. A child, who has watched the page as their parent reads, has been involved in the 'on-going' segmentation forming element of the reading process. This 'top-down' or contour based approach to learning to read may be consistent with early stages of the processes of temporal activation seen in young infants as they respond to the melodic contours of spoken language and melody (Trevarthen, 1999). This parallel, has been implied by Allington (1983, p.557).

It is suggested here that the cognitive orchestration of reading processes between the ear and eye was temporally regulated by the presence of the tape-assisted repeated reading model of reading fluency. The reading model employed by tape-assisted repeated reading enabled the child to intuitively recognize the need for temporally organised prosodic cues in reading.

For children that are recognized as slow learners, research findings indicated that opportunities for meaning-oriented instruction, and encouragement to produce expressive, natural sounding reading were infrequent (Allington, 1983, p.558). The attention of teachers focused on decoding at the phonemic level (ibid). A study by Collins (1982) found that the teaching of slow learning reading groups neglected text-like sentences and stories, leaving the children without a fluent reading model to imitate. A vicious circle has been identified by Allington (1983, p.557) who has observed that a lack of reading fluency is perceived as symptomatic of poor reading along with poor word recognition or poor analysis. This type of diagnosis may have led teachers to believe that the pupils needed further phonics training and further attention paid to words in isolation.

The phonics approach to word recognition retains popularity today and has recently been an area of rapid growth in research (Porkoni et al., 2004, p.147). Difficulties with comprehension are attributed largely to the slow speed of word recognition and low rate of oral reading. Following an investigation into the effectiveness of computer software programmes on children with impaired language and reading capability, Porkoni et al. (2004, p.155) found that both 'Earobics, Step 2' and 'The Lindamood Phoneme

Sequencing Programme for Reading, Spelling, and Speech' ('LiPS') were associated with gains in phonemic awareness when measured 6 weeks after a summer intervention. While 'Earobics' and 'LiPS' were more effective than the 'Fast For Word' ('FFW') programme in improving phonemic awareness, *none* of the programs were associated with significant transfer effects to language or reading at the 6-week post-tests.

Alongside the interest in phonemic awareness in the past fifteen years, some resurgent interest in the importance of reading fluency as an essential component in building overall reading ability was highlighted in the U.S.A.'s National Reading Panel, 2000 (Chard et al., 2002). Following interventions that replicate the 'repeated reading programme' or where the text is presented in chunks to facilitate fluency, researchers cited by Chard et al., (2002) have found links between fluency and reading comprehension.

5.2.4 Summary

The studies conducted between 1990 and 2004 on reading interventions, whether involving 'bottom up' (phonetic) or 'top down' (fluency) approaches, have supported the findings of research studies conducted between 1975-1985. The phonemic approach consistently improves phonemic awareness but not necessarily reading ability. The 'repeated reading programme' consistently appears to develop overall reading ability, although reports of improvements in reading comprehension are inconclusive.

5.3 Experiment 'D'

5.3.1 Aims and Objectives

The fourth experiment in this project, Experiment 'D' was conducted between October 2003 and March 2004. To explore the relationship between recently conducted studies into the phonemic approach to reading intervention and the effect of the music intervention on reading, Experiment 'D' involved a comparison between the music intervention of this project with a highly regarded phonics intervention. By adopting a two treatment design, safeguards were made against any 'halo effect'. A 'halo effect' may have occurred in the previous three field experiments as the controls remained in their usual school lessons.

5.3.2 The location and teaching methods of the host school

The school that participated in Experiment 'D' is situated in a large industrial garden village outside a large town. The garden village, built in the early 20th Century by an industrial magnate for his workers, has been extended with council housing. The industrial works, the Temperance Chapel, the village Post Office and the school constitute the sole communal centres of the village.

The school, educating pupils from 9 to 13 years of age, is fed by a number of lower schools from the surrounding rural area. The school has received government funding through the Education Action Zone initiative from 1999-2005. Facilities in the school include refurbished classrooms, an abundance of computers and interactive whiteboards. Teachers, able to conduct lessons in pristine surroundings, are supported by the very latest educational technology.

Teaching groups are small (approximately 10 pupils), and the staff-to-pupil ratio is higher than usual. Many learning support assistants operate both in the classroom and in resource rooms. 'Brain Gym' (Chapter One, section 1.2.1) has been implemented in this school and all the teaching staff received training to enable them to deliver exercises during most class lessons. Teachers acknowledged with enthusiasm that the behaviour of the pupils had improved since the implementation of the Brain Gym programme.

In spite of these efforts to improve the educational opportunities for the pupils, a severe deficit in attention prevailed. The teachers adapted their delivery of lessons to accommodate the pupils' attention deficit. Two teaching groups were observed. Observations recorded of these lessons, including observational notes of the quality of the pupils' reading, are detailed in Appendix V. The average attention span in the 9-10 years of age teaching group was 3 minutes. The 10-11 years old teaching group had an attention span of 5 minutes. Lesson plans were designed by the teachers to accommodate the short attention span; activities and tasks were of 3 minutes or 5 minutes duration respectively. The lessons that I observed were very strongly framed with an emphasis on meta-cognition[1]during every task. There was a lack of educationally stimulating content in these lessons as the teacher did not attempt to draw upon the children's imaginative potential, or real-life experiences, by using strategies of analogy, suggestion or discussion. Instead, the teacher focused on the indifference and apathy of the pupils who appeared to have no desire to interact with the text. The teacher did not attempt to use strategies that would make the text appear to be relevant and interesting. The attention of the pupils did quickly dissipate, as predicted by the teacher, but the educational stimulation was very limited and unlikely to attract and keep the attention of the pupils during the course of the lessons.

The pupils were instructed to identify the key words from a comprehension question and to locate these in the text, rather than engaging with and developing the pupils' emergent learning, which showed a very low level of reading comprehension. The pupils practised this strategy with frustration and difficulty. The teacher eventually read the sentence containing the key words from the text to the pupils. The pupils did not appear to understand the text they were reading, or, the relevance of the question to the text, or, the answer that they were being trained to provide. Even when they were praised for locating the answer correctly, they still remained unaware of its meaning.

5.3.3 The Participants

Typically, when the school receives new pupils aged 9-10 years, a proportion of these have a reading age of less than 5 years attainment; roughly 4-5 years below their chronological age. By 10 – 11 years old, these pupils will have attained a reading age of 7-8 years. The experimental sample was randomly selected from pupils of the 10 -11 years of age cohort that were known to experience difficulties with reading fluency, reading comprehension or concentration. Their reading age was between 7-8 years, roughly 3-4 years below their chronological age. A local speech pattern prevails in the school with many pupils habitually mispronouncing consonant digraphs as described in

[1] self- awareness for preferred learning behaviour (Reid 1998, p.132)

Chapter Three (sections 3.2.3; 3.4.2). All the pupils in this population, since joining the school, had received extra reading booster classes, extra writing booster classes, and the Brain Gym intervention. All 12 of the participants of the sample, randomly selected from this cohort, were accustomed to receiving special attention in small groups that included participating in unusual strategies for learning such as 'Brain Gym'. These opportunities for focused learning in small groups strengthened the internal validity of Experiment 'D', by minimising any 'halo effects'. The participants were used to being given special attention. One participant was frequently absent from school and missed several intervention sessions as well as two of the three testing days. This participant was omitted from the analysis stage of Experiment 'D'.

5.3.4 The Two Multi-Sensory Treatments in Experiment 'D'

In Experiment 'D' the music intervention treatment was compared with an alternative treatment - phonological awareness training. Phonics training is applied in schools as a remediation strategy by reading specialist teachers in keeping with pedagogic theory that decoding skills are underdeveloped in some children, due to a deficit in phonological awareness, and require intensive remediation.

If the two multi-sensory treatments used in Experiment 'D' are compared, we may notice that both may:

- Be associated with improving reading skills
- Involve stimulating various senses simultaneously
- Work with the learner through a developmental sequence of stages

Contrasts between the two treatments are that the phonics treatment, Alpha to Omega (Hornsby and Shea, 1980) is linguistic and phonetic, whereas the music intervention treatment is not linguistic or phonetic. While the music intervention treatment combines reading behaviour with temporal and vestibular cerebellar stimulation, this level of stimulation was not involved in the Alpha to Omega phonics treatment.

1. The Music Intervention Treatment

The music intervention treatment employed in Experiment 'D' followed exactly the same procedure and musical notation as the music intervention in the three field experiments. The music intervention treatment relied upon the reading material being abstract in character. This is advantageous because any lexical, literary or musical schema, are circumnavigated thereby minimising within sample variation due to cultural or social differences. The musical notation in the 'Stepping Stones' resource does not represent a melody, or cultural information of any description; the spatial distances between the notes are wide, equidistant and provide discernable visual patterns. The recognition of only four notes as 'A', 'D', 'G' and 'C' is required as a 'symbol schema'. The combination of visual-spatial stimulation with the usual sequential processes required in reading probably involves neural pathways being reinforced between right (spatial processing function) and left (sequential processing function) brain hemispheres.

The task of coordinating stamping, clapping and chanting with reading the musical notation provides entrainment and reading skills requiring spatial and sequential and temporal processing. Drake, Jones and Baruch (2000) placed the theory of dynamic attending in a developmental context. Their findings indicated that the higher order time-levels become more accessible with developmental maturation. In this investigation,. The cognitive processes involved during participation in the music intervention arguably refocus dynamic attending on the 'referent level' (Drake, Jones and Baruch, 2000, p.282) which according to the authors would guide the focal attending of the higher order-time levels, necessary for reading comprehension. This cognitive model provides a suitable framework for the empirical work conducted in Experiment 'D'.

2. 'From Alpha to Omega': Phonological Awareness Training

There are a number of phonics programmes available to teachers. The 'Alpha to Omega' (Hornsby & Shear, 1980) programme is widely used by specific learning difficulties tutors. The 'Alpha to Omega' programme, first published in 1974, is a phonetically and linguistically based scheme. Devised by Beve Hornsby & Frula Shear it is based on previously developed work with dyslexics by Anna Gillingham, Bessie Stillman and

Samuel T. Orton dating back to 1930. The phonemes of the English language are taught by a system of *Flashcards,* displaying phonemes such as **'spl'** or **'thr'**, as an intrinsic element of 'Alpha to Omega'. The administration of the Flashcards is carefully described as a *'Drill for teaching letters and their sounds'* in Appendix VI.

The drill offers a multi-sensory treatment that contrasted well with the music intervention treatment. The participants were presented with each *flashcard* individually. They took turns rather than participating simultaneously as a group. This slower approach was deliberately chosen to avoid any group response inducing an, 'entrainment' effect similar to rhythmic chanting. Following the multi-sensory *flashcard* drill, word attack skills were addressed by putting sounds together utilising *onset and rime*. For example, the rime **'and'** may be combined with the onsets **'b', 'h', 'l'** to form **'band', 'hand', 'land'** etc. A lack of competency in word attack skills is thought (Perfetti, 1985) to hinder reading development.

In the onset and rime exercises; the participants were invited to think of the answer and to put up their hands. At first the participants responded slowly and there was no risk of a rhythmic answering pattern developing within the group. In the first session the group was asked to write down the rime **'ed'** and then asked what word they would make if they started with the sound **'b'**? After a pause it was explained that the answer was **'bed'** and that the two sounds fitted together to produce this word. The group were amazed; 'I never knew that!' exclaimed one boy.

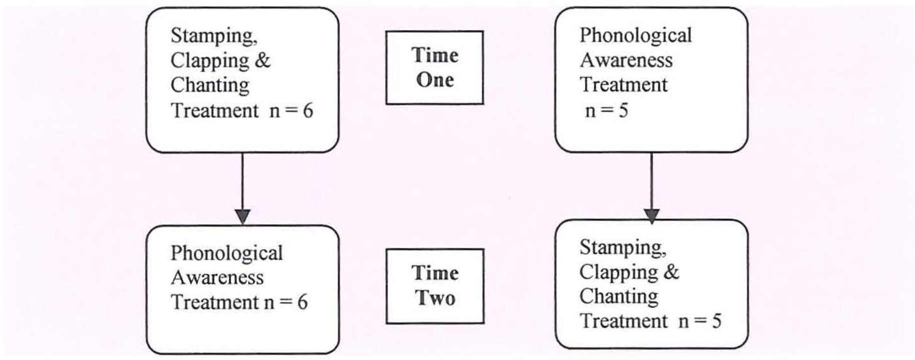
After a few weeks the group became quite confident at manipulating sounds and moulding these into words. By practising these skills, their auditory discrimination and ability to visually decode graphemes into phonemes would have been developing concurrently. These phonological awareness treatment sessions were ten minutes in length. The participants were recognised as having a concentration span of only 5 minutes duration; each session would have been challenging for their attention span. Some behavioural problems did arise during the sessions from two disruptive individuals.

Careful records were kept of all the phonological training sessions for future replication and to monitor the progress of the participants.

5.3.5 A Two Treatment Design

The two-treatment design in Experiment 'D' involved two groups of participants receiving two contrasting treatments for six sessions in a period of six weeks in each treatment period, see fig. 5.1. The 12 participants were organised into pairs matched for ability in reading comprehension (Appendix IV). The individuals of the pair were randomly assigned to one of the two contrasting treatments in Time One. Both treatment groups were expected to swap over and receive the alternative treatment in Time Two. Measures of reading behaviour and phonological awareness were taken on three testing days (i) pre-tests before Time One, (ii) mid-tests after Time One but before Time Two, (iii) post-tests after Time Two.

Fig.5. 1 A diagrammatic representation of the experimental design



5.3.6 Methods of Assessment

An additional assessment measure was included in Experiment 'D' to measure any changes in phonological discrimination and word attack skills following participation in the phonics treatment. The 'Phonological Assessment Battery', (Frederickson et al, 1997) offers a selection of short individually administered tests to assess phonological discrimination. Ample practice items allowed the participants to become comfortable with the test questions before the measurement began. Two subtests were selected for Experiment 'D': the 'Alliteration Test' and the 'Rhyme Test'. In these subtests the tester read three words aloud. Two words have similar phonemes and one has not. Each participant was asked to identify and name the word that had a different sound.

The 'Alliteration Test' measured phonological discrimination at the beginning of the word; for example: 'crane', 'great' and 'grain' where the two words having the same onset are, 'great' and 'grain'. The 'Rhyme Test' measured phonological discrimination at the ending of a word; for example: 'dish', 'wish' and 'whisk' where two words have the same rime: 'dish' and 'wish'. The tester was instructed not to modulate their voice on the third word; this modulation would naturally occur otherwise. The scores were recorded on a record sheet where the tester ticked each answer that was correct. The number of correct answers constituted the raw score.
The Neale Analysis of Reading, (Neale, 1989) was also included in Experiment 'D'. This individually administered reading assessment test has been described in Chapter Three (section 3.3.4).

5.3.7 Method of Analysis

Digital recordings of the participants' reading behaviour were collected on mini-disc at three points in time:

- Pre-tests in October
- Mid-tests in January
- Post-tests in February

The baseline score for reading comprehension was used to organise the sample into matched pairs (Appendix IV) which were randomly allocated to the two treatments. Group 1 and Group 2 were therefore matched by ability in reading comprehension at the time of pre-testing. During each data collection for the Neale Analysis of Reading, (Neale, 1989) all the participants were tested at the reading level appropriate to their reading ability. When a marked improvement in reading appeared to have occurred, the participant read the passage of text appropriate to their initial level of capability and then the passage of text that was appropriate to their current level of reading competence. This has resulted in some individuals at the post-tests, reading texts of a standard that would not have been appropriate for them to attempt in the pre-tests. The analysis was rationalised to accommodate differences between the texts. The reading comprehension scores were standardised to reading level 4, which was the median reading level in this sample. The standardisation process was developed using Table 5B: 'Form 2, Revised British Edition – Mean (x) and Standard Deviation (SD) for Total Number of Comprehension Questions Correctly Answered' (Neale 1989, p.46) where Level of Reading was set against Age Group. The difference between each Level of Reading for 11:00-11:11 age group is a 12.5% decrease as the Level of Reading increases. Therefore a 50% score at Level 5 is equivalent to a 62.5% score at Level 4. When, if more than one reading score has been attempted on one testing occasion, there remained a discrepancy between the two scores after the above adjustment, the mean score between these two scores was calculated and entered into the database.

Questions to be answered by the analyses

- Was there any significant change in reading behaviour between the groups receiving contrasting treatments?
- Were there any interaction effects that suggest whether particular participants benefited from the treatments more than others?

5.3.8 Results for Time 1

The findings are set out in Tables 5.1a and 5.1b, and fig. 5.2. A multivariate analysis of variance between the two treatment groups was made. The before scores were collected at the pre-tests before the first treatment period began and the after scores were collected at the mid-testing point following Time 1. In Fig 5.2 the bars illustrate differences in reading comprehension scores following participation in the two different intervention treatments. The differences between the groups illustrate a trend in the predicted direction for the change in reading comprehension scores with greater gains in reading comprehension for the music intervention group although the change was not statistically significant.

In Table 5.1a and 5.1b., and figure 5.2, the findings show no statistically significant effect in the change between the before and after phonological discrimination scores, reading accuracy, reading rate or reading comprehension scores for the two treatment groups in

Time 1 although a trend in the predicted direction is clear in the mean change in reading comprehension score.

Table 5.1a recorded that a similar improvement in reading rate occurred in the group receiving phonological awareness training treatment and the group receiving the music intervention treatment. In the phonological treatment group, the before treatment rate of reading mean score was 56.38 and the after treatment mean score was 69.36. In the music intervention group, the before treatment mean score was 50.64 and the after treatment mean score was 63.64. The mean change in rate of reading for the phonological awareness treatment group was 12.98 words per minute and for the music intervention treatment group the mean change for rate of reading was 13 words per minute.

A more prominent improvement in reading comprehension was found for the music intervention treatment group than for the group receiving phonological awareness training. The reading comprehension scores for the phonological awareness training group before treatment was 22.5 and after treatment the mean score was 30.00 with a mean change of 7.5. For the music intervention treatment group, the before treatment mean score was 22.92 and following treatment, the mean score was 47.92. The mean change scores for the music intervention treatment group showed an increase of 25.00 in reading comprehension.

There were modest improvements in the reading accuracy scores for both treatment groups. The group that had received phonological awareness training were found to have a before treatment mean score of 53.75 and a mean score of 60.00 following treatment. This group were found to have gained in their mean score by 6.25. The group that had received the music intervention treatment were found to have a before treatment mean score of 13.75 and an after treatment mean score of 15.01. The music intervention treatment group improved their reading accuracy mean score by 1.26.

Table 5.1a. Mean differences between treatments in Neale Analysis of Reading Ability scores at Time 1

	Mean		Std D.		Mean	Std D.	df	F.	Sig.
	Phonics Treatment 1. n = 5	Music Treatment 2. n = 6	Phonics Treatment 1.	Music Treatment 2.	Overall				
Reading Comprehension Before	22.5	22.92	16.30	22.94	22.73	19.23			
Reading Comprehension After	30.00	47.92	33.77	28.14	39.77	30.65			
Change in Reading Comprehension	7.50	25.00	28.77	26.22	17.05	27.54	1	.395	NS
Reading Accuracy Before	53.75	13.75	18.00	39.87	33.75	35.99			
Reading Accuracy After	60.00	15.01	25.99	36.06	37.51	37.95			
Change in Reading Accuracy	6.25	1.26	19.76	41.54	3.76	32.15	1	.088	NS
Reading Rate Before	56.38	50.64	18.22	18.72	53.51	17.67			
Reading Rate After	69.36	63.64	28.33	19.15	66.50	22.99			
Change in Reading Rate	12.98	13.00	22.74	52.99	12.99	32.15	1	1.541	N.S.

Fig. 5.2. Comparison of the change in reading comprehension scores between treatments 1 and 2 at the end of Time 1.

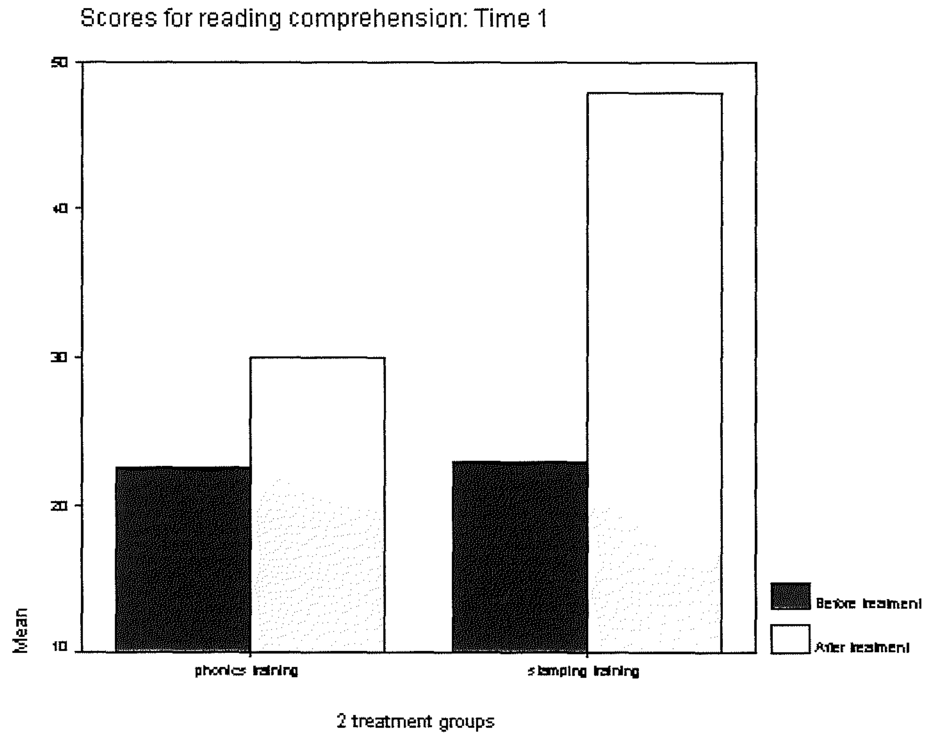


Table 5.1b recorded no statistically significant effect in the Alliteration item of the PHAB battery (Frederickson et al, 1997) of phonological discrimination. The mean pre-test score for the phonological awareness treatment group was 92.00, the mean post-test score was 100, the mean change score was 8.00. For the music intervention group, the mean pre-test score of 86.67 remained unchanged after participation in the music intervention treatment.

Findings in Table 5.1b show that small improvements were found for both groups in the Rhyme Test (Frederickson et al, 1997) of phonological discrimination. The group that had received phonological awareness training showed a before treatment mean score of 74.28 and an after treatment mean score of 77.14 their mean score change was 2.86. The music intervention treatment group were found to have a before treatment mean score of

68.24 and an after treatment mean score of 70.63. They were found to have improved their mean score by 2.39.

Table 5.1b. Mean differences between phonological awareness (PHAB) scores before and after treatments 1 and 2 at Time 1:

	Mean		Std D		Mean	Std D	df	F	Sig.
	Phonics Treatment 1. n = 5	**Music Treatment 2. n = 6**	**Phonics Treatment 1.**	**Music Treatment 2.**	**Overall**				
Phonological Alliteration Before	**92.00**	**86.67**	**13.04**	**17.51**	**89.09**	**15.13**			
Phonological Alliteration After	**100.0**	**86.67**	-	**10.33**	**92.73**	**10.09**			
Change in Phonological Aliteration	**8.00**	**0.00**	**13.04**	**16.73**	**3.64**	**15.01**	**1**	**.615**	**N.S.**
Phonological Rhyme Before	**74.28**	**68.24**	**9.87**	**14.67**	**70.98**	**12.51**			
Phonological Rhyme After	**77.14**	**70.63**	**12.33**	**11.03**	**73.59**	**11.54**			
Change in Phonological Rhyme	**2.86**	**2.40**	**9.87**	**9.89**	**2.61**	**9.38**	**1**	**.087**	**N.S.**

5.3.9. Evaluation of the design[2]

During Time 1, despite the organisational efforts on the part of the school staff, there were a relatively large number of participant absences and persistent loss of intervention time as participants frequently forgot to attend sessions, were late or were involved in school activities elsewhere on the site. Similarly, sports injuries among the music intervention group prevented full participation in this activity for some. Poor behaviour stemming from two participants in the phonological awareness group led to deliberate disruption of these sessions. For these reasons, the treatment sessions proceeded less smoothly than had been hoped and a lack of continuity for some participants did occur.

[2] The findings of the mid-test results are discussed with the post-test results in 5.3.14

The mid-tests collected after Time 1 but before Time 2, yielded findings with implications that threatened the validity of the proposed two-treatment design. The inconsistencies in terms of attendance contributed to the slow progress of the participants in achieving the expected level of competence during the treatment sessions. The participants in the music intervention group were expected to have achieved temporal control and coordination of their actions by the end of the six-week period of Time 1. However, by that point in time only 2 of the 6 participants had achieved a reliable level of temporal control and coordination. Similarly, in the phonological awareness group, only 1 of the 6 participants was thought to be confident in decoding and manipulating phonics by the end of the treatment period.

5.3.10 Adapting the Design

The experimental design, illustrated in fig. 5.1., section 5.3.5, involved two participant groups that were randomly assigned to two contrasting treatments. After the mid-tests, the two groups were expected to receive the alternative treatment during Time Two and were to be retested and compared in the post-tests at the end of Time Two. Several factors influenced a change in the experimental design at the end of Time 1:

- The slow and awkward progress of the participants during the two treatments in Time 1, indicated that the period of time (5 weeks) allocated to the intervention in Time 2 was inadequate for the participants to achieve the expected level of competence in temporal control of their physical coordination in the music intervention activity.

- The overall length of each treatment period was strictly limited to two half term sessions (of 6 weeks and then 5 weeks) with the Christmas holiday in between these periods. As the participants were 10-11 years old, they were to sit S.A.T.S. examinations in the coming May. The school were understandably committed to resuming a fully uninterrupted timetable from the second part of the Spring Term onwards for this cohort.

- As an ethically motivated project the prime aim, and principal motive for offering the intervention treatment sessions to the host school, had been to investigate an intervention strategy for *improving* reading comprehension scores. Limiting the number of sessions in either treatment period (Time One or Time Two) to only 5 or 6 weeks would imply that the majority of participants, in this particular setting, would experience minimal benefit from each treatment. The prime aim of the project would remain unfulfilled if the outcome of the treatment period of Time 2 followed the disappointingly slow response pattern that emerged from Time 1.

The participants may have responded fully to the treatments in Time 1, and achieved the expected level of competence in temporal control of their physical coordination in the music intervention if it had been possible to expose them to additional treatment sessions over a much longer, extended treatment period. Time constraints indicated that an extension of the experiment would be impossible to arrange with the school. Alternatively, if the experimental design remained unaltered and the time constraints of the school remained in place, it was unlikely that there would be any effects of participating in Experiment ‘D’.

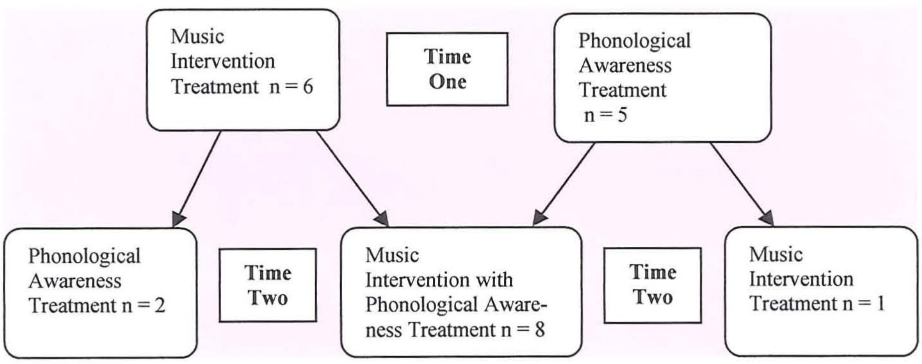
It was decided to adapt the experimental design to accommodate the time constraints of the school and the substantial educational needs of the participants. At this point in the progress of the experiment, the mid-tests had been conducted after the Time One treatment period. Based on the results at the end of Time 1 each participant was allocated, for the treatment period of Time 2, to the most appropriate combination of treatments for an appropriate time period to meet their individual educational needs.

Differing levels of ability in the stamping, clapping and chanting activity were found to persist between the participants that had received the music intervention. The two pupils who were able to perform the music intervention activity with confidence at the end of Time One did not require an extended period of exposure to the music intervention in Time Two. The remaining four pupils of that group were considered to have improved their skills in performing the music intervention activity at the end of Time One, though it was predicted that further improvement, and increased confidence, would occur with further exposure to the music intervention in Time Two.

Similarly, variation in phonological awareness was found at the end of Time One in the phonological awareness intervention group. One participant was found to be confident in phonological discrimination at the end of Time One but the other members of the group were divided into two sub-groups. One sub-group consisted of one participant who made minor errors in the intervention treatment sessions; the second sub-group consisted of three participants who made consistently fundamental errors during the intervention treatment sessions. The sub-groups required differing lengths of extended exposure to the phonological awareness intervention in Time Two. The confident participant did not require an extended period of exposure to the phonological awareness intervention treatment. The participant that made minor errors required two further sessions of phonological awareness treatment. The three participants that made consistently fundamental errors in phonological discrimination, required a further five weeks of exposure to the phonological awareness treatment sessions.

The adaptation of the original experimental design, in figure, 5.1a, section 5.3.5, is set out here in figure 5.3, permitted the experiment to proceed within the school's stipulated time constraints while maximising the likelihood of the participants experiencing some benefit from the interventions.

Fig. 5.3 A diagrammatic representation of the adapted experimental design



The advantage of adapting the experimental design was that the overall aim of the interventions was more likely to be fulfilled. The disadvantage of the design change was that experimentally, the between group contrasts and the between treatment contrasts, anticipated in Time 2, would not be achieved. However, the adapted version of the experimental design provided an opportunity for each participant to receive both treatments and to receive an extended period of the treatment that they had received in Time 1. This extended treatment period increased the likelihood that the participants might achieve success in temporal control of their physical coordination in the stamping, clapping and chanting exercises and increased awareness and discrimination of phonics; the impact of the extended periods of participation was to be assessed. Alternative analytical procedures were adopted to accommodate the lack of internal validity concerning erosion of between group and between treatment experimental contrasts. The considerably high incidence of between participant differences within the sample threatened external validity.

By acknowledging the high incidence of within sample variation and by providing appropriate treatment sessions for the individual educational needs of participants, within sample variation was assimilated into the experimental design. It was hoped that by adapting the design of the experiment, the likelihood of committing Type II error (a false negative finding) was reduced. The treatments for Time 2 were allocated to the participants as detailed in Fig.5.3.

Findings of the mid-tests and the adaptation of the experimental design revealed that some of the participants had not reached the criterion at the end of Time One, indicating confidence in the music intervention activity of stamping, clapping and chanting. For this reason the music intervention treatment was extended for 4 of the 6 participants who had received this treatment in Time 1. One of the 4 received two weeks' extended treatment; the remaining 3 received five weeks of the extended treatment. All 6 participants in this group (music intervention treatment in Time 1) also received the phonological awareness treatment for five weeks in Time 2.

The phonological awareness treatment was extended for 4 out of the 5 participants who had received this treatment in Time 1 because the errors they made at the end of Time One, indicated further training in phonological awareness would benefit their phonological discrimination skills. One of the 4 received two weeks of extended treatment while the remaining 3 received five weeks of extended phonological awareness treatment. All 5 participants in this group (phonological awareness treatment in Time 1) also participated in the music intervention treatment in Time 2.

5.3.11 The adapted design and the organisation of the statistical sample for analysis

The design of Experiment 'D' was adapted to accommodate the slow response of the participants. The slow response of the participants was measured by their progress and performance in the intervention sessions and by performance in the mid-tests. The raw scores for individual participants indicated differences in response. These are presented in Tables 5.2a and 5.2b.

Table 5.2a The decision taken for each numbered individual following participation in the music intervention in Time 1.

Decision taken based upon competency in stamping, clapping and chanting activity for individual participants.		**Scores describing change in reading comprehension and phonological discrimination following participation in the music intervention. These scores did not influence the decision described in column one of this table. The scores are presented here for interest only.**			
Decision	Participant	Reading Comprehension Pre-test raw scores %	Reading Comprehension Mid-test raw scores %	PHAB Rhyme Pre-test raw score %	PHAB Rhyme Mid-test raw score %
No extra exposure to Mus.Int. required	1	12.5 at level 3	75 at level 3 50 at level 4	71	81
Some extra exposure to Mus. Int. required	2	50 at level 4	87.5 at level 4 37.5 at level 5	66	66
No extra exposure to Mus. Int. required	3	62.5 at level 3	75 at level 3 75 at level 4	52	66
Maximum exposure to Mus. Int. required	4	0 at level 5	12.5 at level 5	81	76
Some extra exposure to Mus. Int. required	5	12.5 at level 3	50 at level 3	76	81
Maximum exposure to Mus. Int. required	6	37.5 at level 3	25 at level 3	52	52

Table 5.2b The decision taken for each numbered individual following participation in the phonics intervention in Time 1.

Decision taken based upon competency in multi-sensory phonics intervention sessions for individual participants.		**Scores describing change in reading comprehension and phonological discrimination following participation in the phonics intervention. These scores did not influence the decision described in column one of this table. The scores are presented here for interest only.**			
Decision	Participant	Reading Comprehension Pre-test raw scores %	Reading Comprehension Mid-test raw scores %	PHAB Rhyme Pre-test raw score %	PHAB Rhyme Mid-test raw score %
Some extra exposure to Phon. Int. required	7	12.5 at level 5	12.5 at level 5	66	76
No extra exposure to Phon. Int. required	8	25 at level 3	62.5 at level 3 50 at level 4	76	90
Maximum exposure to Phon. Int. required	9	37.3 at level 4	75 at level 4	76	81
Maximum exposure to Phon. Int. required	10	50 at level 3	25 at level 3	62	57
Maximum exposure to Phon. Int. required	11	12.5 at level 3	0 at level 3	86	76

The consistent pattern of progress demonstrated by the participants in the three field experiments (Chapter Four, section 4.5.1), generated the expectation that after 6 weeks, the participants in the music intervention treatment of Experiment 'D' would have achieved confident control and coordination in the stamping, clapping and chanting activity. However, after six weeks, four of the participants were only able to achieve intermittent control in the music intervention activity. For this reason, it was assumed that further exposure to the music intervention was required before these participants could be considered as having benefited from participating in the experiment.

Four of the participants in the phonological awareness intervention treatment had demonstrated an under-developed awareness of phonemes and word synthesis; it was hoped that by extending the period of exposure to the phonics treatment, that they would benefit from participating in the experiment. The time constraints within which the school operated prohibited any opportunity to preserve the original experimental design by extending the experimental period. Instead, the sample was assigned to the most appropriate treatments that would benefit them as individuals (as shown in Fig. 5.3, section 5.3.10). A summary of the treatments received by the participants is set out in Table 5.3.

Table 5.3. A summary of treatments received by participants in the adapted experimental design

Participant	Time 1	Time 1	Time 2	Time 2	Time 2	Time 2
	Music Treatment (6 weeks)	**Phonics Treatment (6 weeks)**	**Music Treatment (5 weeks)**	**Phonics Treatment (5 weeks)**	**Music & Phonics (3 /5weeks)**	**Music & Phonics (5 weeks)**
1	*			*		
2	*					*
3	*			*		
4	*					*
5	*					*
6	*					*
7		*			*	
8		*	*			
9		*				*
10		*				*
11		*				*

The handling of the data was also modified to accommodate the changes in the design of the experiment. One of the participants was absent during two of the testing dates and therefore not included in the data set. The summary in Table 5.3, shows that the eroded contrast between Time One and Time Two occurred because the treatment sessions in Time Two involved most participants in both treatment activities.

The method of analysis for Experiment 'D' was adapted by organising the sample into three groups according to the quantity of phonological awareness training that individuals had received overall. To prevent any within group variation in the quantity of phonological awareness treatment received, only the participants that received between 5 and 7 weeks of phonological awareness treatment were included in this analysis. Group1 included the participants that received the music intervention treatment only (i.e. participants 1-6 from Time 1 and participant 8 from Time 2). Group 2 included the participants that received between 5 and 7 sessions of phonological awareness training only (i.e. participants 7-11 from Time 1 and participants 1 and 3 from Time 2). Group 3 included the participants that received between 5 and 7 weeks of phonological training and the music intervention (i.e. participants 2 and 4-7 from Time 2). A later analysis included Group 3A participants that received up to 10 weeks of phonological training and the music intervention (i.e. participants 2 and 4-7 and 9-11 from Time 2).

5.3.12 Results for Time 2

The results set out in Table 5.4., and, Fig.5.4. describe a multivariate analysis between the two contrasting groups. To prevent within group variation in the amount of phonological awareness treatment received, all the participants that received 5-7 weeks of phonological awareness treatment were included in this analysis. Group1 included the participants that received 5-7 sessions of phonological awareness treatment only. The participants that received 5-7 sessions of phonological awareness training combined with the music intervention treatment made up Group 2.

In Table 5.4., the findings show a statistically significant effect in the change in reading comprehension scores, (p = .034) between Group 1 that received 5-7 weeks of phonological awareness training only and Group 2 that received both 5-7 weeks of phonological awareness training combined with the music intervention treatment. There were no significant findings for other dependent variables that measured phonological discrimination scores, reading accuracy or reading rate scores for the two treatment groups in Time 2. This finding is summarised in figure 5.4.

The statistical analysis of the reading comprehension measure, showed a statistically significant change between Group 1 and Group 2 (p = .034). For Group 1, the before treatment reading comprehension mean score was 38.39 and the after treatment mean score was 37.50. For Group 2, the before treatment mean score for reading comprehension was 28.91 and the after treatment mean score was 74.22. The difference in the reading comprehension mean score for Group 1 was a decrease of 0.89 whereas the corresponding difference in the reading comprehension mean score for Group 2 was an increase of 45.31.

The analysis of the dependent variable rate of reading was found to be statistically not significant. The mean score before the treatment for Group 1 was 60.08 and after the treatment, the mean score for Group 1 was 65.01. For Group 2, the rate of reading mean score before treatment was 60.04 and after the treatment, the mean score was 63.84. Both Group 1 and Group 2 were found to have experienced similar increases following the treatment in the mean change score. For Group 1 there was an increase of 4.93 in the mean score and an increase of 3.8 was found for Group 2.

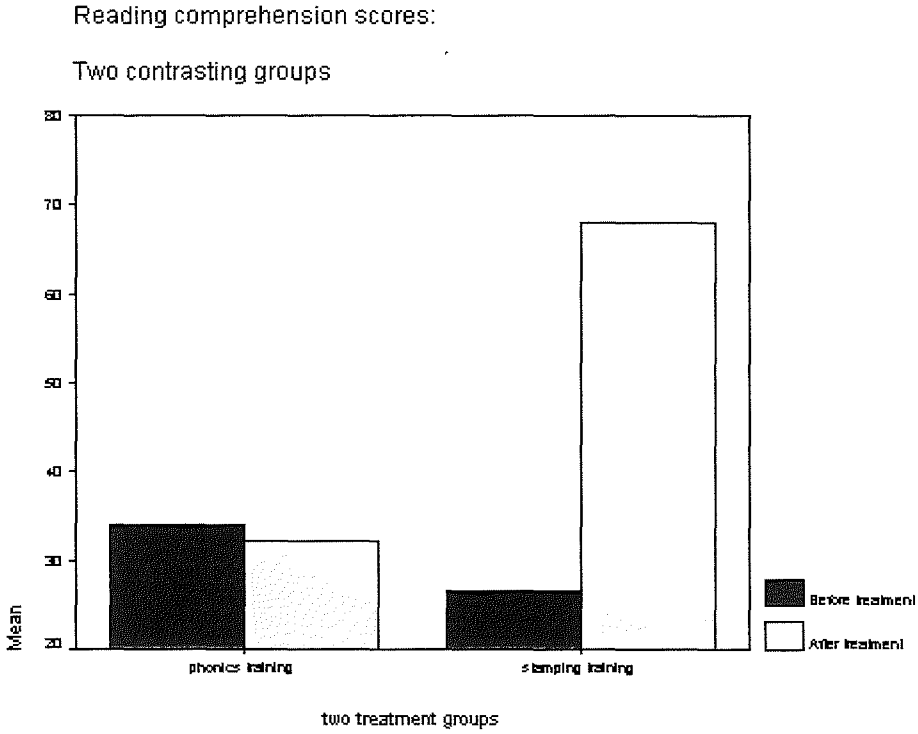
The reading accuracy dependent variable was found to be statistically non-significant. Both the groups were found to have changed only very slightly. The before treatment mean score in reading accuracy for Group 1 was 58.03 and the after treatment mean score for Group 1 was 57.14. For Group 2, the before treatment mean score was 32.15. An after treatment mean score 33.03 was found for Group 2. The mean change scores indicate a small mean score decrease of 0.89 for Group 1 and a small mean score increase of 0.88 for Group 2.

Table 5. 4a: Data from Time 1 and Time 2 between two contrasting groups in a multivariate analysis of variance

	Mean		Std D.		Mean	Std D.	df	F.	Sig.
	Group 1 n = 7	Group 2 n = 8	Group 1	Group 2	Overall				
Reading Comprehension Before	38.39	28.91	25.62	22.39	33.33	23.58			
Reading Comprehension After	37.50	74.22	28.87	18.43	57.08	29.77			
Change in Reading Comprehension	-0.89	45.31	27.58	23.38	23.75	33.63	1	5.817	.034
Reading Accuracy Before	58.03	32.15	16.81	41.98	45.09	33.53			
Reading Accuracy After	57.14	33.03	22.14	29.26	45.09	28.19			
Change in Reading Accuracy	-0.89	0.88	20.54	16.97	0.00	18.04	1	0.290	N.S.
Reading Rate Before	60.08	60.04	17.71	21.38	64.06	19.31			
Reading Rate After	65.01	63.84	27.59	27.70	64.43	26.56			
Change in Rate of Reading	4.93	3.80	20.38	14.93	0.37	17.81	1	2.133	N.S.

N.B.: Group 1 received 5-7 weeks of phonological awareness treatment. Group 2 received both the music intervention treatment and 5-7 weeks of phonological awareness treatment.

Fig 5.4 Bar chart illustrating differences in mean reading comprehension scores between Group 1 and Group 2 derived from Time 1 and Time 2



In Table 5.4b, findings in the analysis of Rhyme (a test of phonological discrimination at word endings) (Frederickson et al, 1997) a statistically non-significant result was found. The before treatment mean score for Group 1 was 71.14 and the after treatment mean score for Group 1 in Rhyme was 77.55. The corresponding score for Group 2 was a before treatment mean score of 68.69 and an after treatment mean score of 80.95. The mean change scores show increased scores for both groups. An increase of 3.41 was found for Group 1; an increase of 12.26 was found for Group 2.

In the analysis of Alliteration (a test of phonological discrimination at the onset of words) (Frederickson et al, 1997) the findings were statistically non-significant. The findings for Group 1 show a before treatment mean score of 92.86 and an after treatment mean score of 100. For Group 2, the before treatment mean score was 85.00 and the after treatment mean score was 96.25. Similar increases in the mean score after treatment were found for both the groups. A mean score increase of 7.14 was found for Group 1; a mean score increase of 11.25 was found for Group 2.

Table 5. 4b : Data from Time 1 and Time 2 between two contrasting groups in a multivariate analysis of variance.

	Mean		Std D.		Mean	Std D.	df	F.	Sig.
	Group 1. n = 7	Group 2. n = 8	Group 1.	Group 2.	Overall				
Phonological Alliteration Before	92.86	85.00	11.13	14.14	88..66	13.02			
Phonological Alliteration After	100	96.25	-	10.60	98.00	7.74			
Change in Phonological Aliteration	7.14	11.25	11.12	13.56	9.33	12.22	1	0.041	N.S.
Phonological Rhyme Before	74.14	68.69	9.06	12.27	71.42	10.74			
Phonological Rhyme After	77.55	80.95	10.18	14.02	79.25	11.00			
Change in Phonological Rhyme	3.41	12.26	8.56	7.20	7.83	8.21	1	3.036	N.S.

N.B.: Group 1 received 5-7 weeks of phonological awareness treatment. Group 2 received both the music intervention treatment and 5-7 weeks of phonological awareness treatment.

Explanation

Following the statistically significant finding, in Table 5.4a for the dependent variable, reading comprehension, the data was analysed further. A between three groups contrast was made to explore any effect of the extended treatment sessions in Time 2. The findings of the analysis between three groups are presented in Tables 5.5a/b., and, 5.6a/b. In both Tables 5.5a/b, and 5.6a/b, the analyses of contrasts between the scores of three groups are presented: Group 1 that received 5-7 weeks of the music intervention treatment only, Group 2 that received 5-7 weeks of phonological awareness training only, and, Group 3[3] that received both the music intervention treatment and 5-7 weeks of phonological awareness training combined.

[3] In Table 5.6a/b Group 3 is referred to as Group 3A to include the participants that received both the music intervention and up to 10 weeks on phonological awareness training.

The reliability and validity of multivariate analyses become questionable when an increased number of factors are involved in a single analysis. An increased number of dependent variables in a multivariate analysis are thought by statisticians to increase the likelihood of 'error' in the analysis (Kerr, Hall & Kozub, 2002, p.156). Unlike previous tables that present multivariate analyses of variance, where there have been two contrasting groups of participants, in both, Tables 5.5a, 5.5b and 5.6a,5.6b there are three contrasting groups of participants and five dependent variables for only a small sample. The small group sizes had implications for the reliability of the significant findings. Different levels of significance were found depending on the number of dependent variables in the MANOVA calculation. Each dependent variable was analysed in a one-way ANOVA to establish the level of significance. It was found that when three dependent variables were included in the MANOVA, the significance levels corresponded with those of the separate one-way ANOVA calculations. For this reason, two multivariate analyses were conducted for each table, each MANOVA computed three dependent variables; the least significant dependent variable, reading accuracy was computed in both analyses.

5.3.13 Results of further analyses

Table 5.5a shows that significant effects were found for rate of reading and for reading comprehension. There were no statistically significant findings for the other dependent variables: phonological discrimination scores or reading accuracy scores.

The findings for rate of reading were statistically significant ($p = 0.017$). For Group 1, that received only the music intervention, the mean score for rate of reading before treatment was 57.83 and after treatment was 73.62. The rate of reading mean scores for Group 2, that received 5-7 weeks of phonological training only, were 60.08 before treatment and 65.61 after the treatment. In Group 3, that received 5-7 weeks of phonics treatment combined with the music intervention, the mean score before treatment was 67.66 and after treatment the mean score was 53.68. The rate of reading for Group 1 increased by 15.79 words per minute and in Group 2 by 5.53 words per minute. For Group 3 a decrease in the rate of reading of 13.98 words per minute was recorded.

Findings set out in Table 5.5a, show that no effect was found for the reading accuracy measure. The reading accuracy mean score for Group 1 was 27.08 before treatment and 26.05 after treatment. For Group 2 the before treatment mean score was 58.04 and the after treatment mean score was 57.14. The before treatment mean score for Group 3 was 17.51 and 22.49 following treatment. Group 1 and Group 2 experienced small decreases in mean change score: 1.03 for Group 1 and 0.9 for Group 2. There was an increase of 4.98 in the mean change reading accuracy score for Group 3.

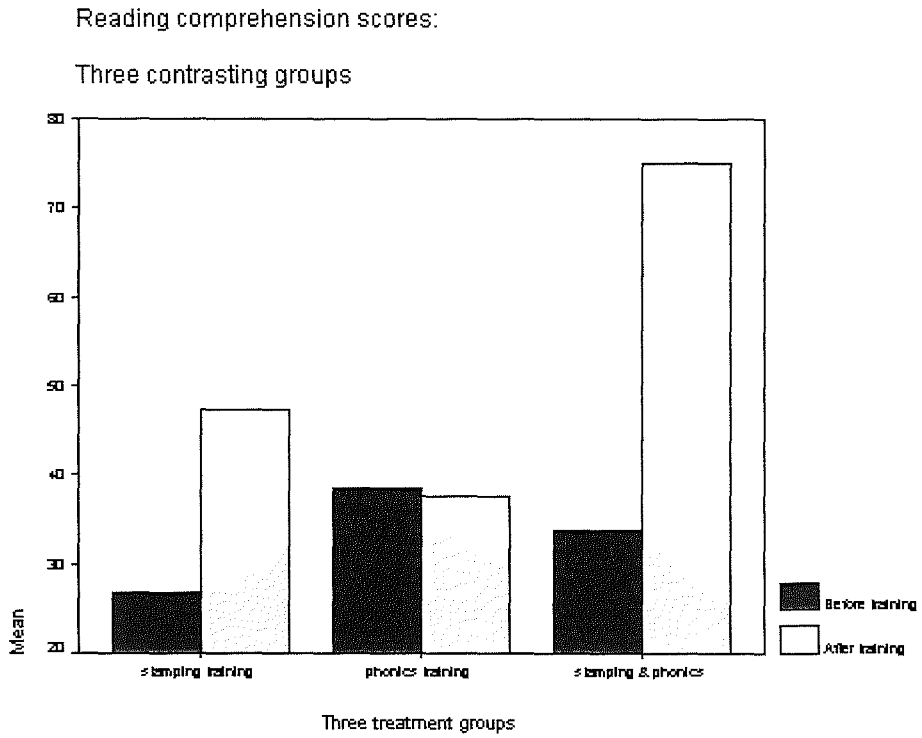
In Table 5.5a, statistically significant effects were found for the reading comprehension dependent variable ($p = .046$). The mean score for Group 1, (the music intervention group) before treatment was 26.79, and after treatment the mean score for Group 1 was 47.32. For Group 2, (the 5-7 weeks of phonics training group) the mean score for reading comprehension before treatment was 38.39 and after treatment the mean score was 37.50. The reading comprehension mean score for Group 3 (the combined treatments group, with 5-7 weeks phonological awareness) before treatment was 33.75 and the mean score was 75.00 after treatment. For Group 1 an increase of 20.53 in the mean score was recorded. Following treatment, a decrease of 0.89 was recorded in the mean score of Group 2. For Group 3 an increase of 41.25 was recorded in the mean score following treatment. These changes in the mean score are summarised in Fig. 5.5.

Table 5.5a Data from Time 1 and Time 2, between three contrasting groups in two multivariate analyses of variance.

	Mean			Standard Deviation			Mean	Std D.	df	F.	Sig.
	Group 1. n = 7	**Group 2. n = 7**	**Group 3. n = 5**	**Group 1.**	**Group 2.**	**Group 3.**	**Overall**				
Reading Comprehension Before	**26.79**	**38.39**	**33.75**	**23.31**	**25.62**	**21.47**	**32.89**	**23.00**			
Reading Comprehension After	**47.32**	**37.50**	**75.00**	**22.49**	**28.87**	**21.65**	**53.27**	**28.05**			
Change in Reading Comprehension	**20.53**	**-0.89**	**41.25**	**26.12**	**27.58**	**28.09**	**20.38**	**31.05**	**1**	**3.814**	**.046**
Reading Accuracy Before	**27.08**	**58.04**	**17.51**	**48.36**	**16.81**	**40.35**	**36.46**	**38.72**			
Reading Accuracy After	**26.05**	**57.14**	**22.49**	**42.09**	**22.94**	**23.65**	**37.15**	**37.15**			
Change in Reading Accuracy	**-1.03**	**-0.90**	**4.98**	**26.98**	**20.55**	**19.74**	**0.69**	**21.88**	**1**	**0.101**	**N.S.**
Reading Rate Before	**57.83**	**60.08**	**67.66**	**24.29**	**17.71**	**19.46**	**61.44**	**19.75**			
Reading Rate After	**73.62**	**65.61**	**53.68**	**29.24**	**27.59**	**13.13**	**64.63**	**24.95**			
Change in Reading Rate	**15.79**	**5.53**	**-13.98**	**5.25**	**20.38**	**10.20**	**3.19**	**14.22**	**1**	**5.413**	**.017**

N.B.: Group 1: music intervention treatment only, Group 2: 5-7 weeks of phonological awareness only, Group 3: both music intervention and 5-7 weeks of phonological awareness only.

Fig. 5.5: Bar chart illustrating reading comprehension scores from Time 1 and Time 2 between three contrasting groups



In Table 5.5b there was a statistically non-significant finding for the Rhyme Test (Frederickson et al, 1997). For Group 1 the mean score before treatment was 68.23 and after treatment the mean score was 71.42. The mean rhyme score for Group 2 was 74.15 before treatment and 77.55 after treatment. For Group 3, the mean rhyme score was 71.43 before treatment and 81.90 following treatment. Similar gains in rhyme were made in the mean score for Group 1: 3.19 and for Group 2: 3.4. For Group 3 a larger increase in the mean rhyme score of 10.47 was recorded.

Findings recorded for the Alliteration Test (Frederickson et al, 1997) showed a statistically non-significant result in Table 5.5b. The mean score, 88.57, for Group 1 was unchanged following the treatment. For Group 2 the mean score before the treatment was 92.86 and 100 after the treatment. The mean score before treatment for Group 3 was 88.00 and 94.00 following treatment. Similar gains in the Alliteration Test were made:

7.14 by Group 2 and 6.00 by Group 3. There was no change in the mean score for Group 1.

Table 5.5b Data from Time 1 and Time 2, between three contrasting groups in two multivariate analyses of variance.

	Mean			Std D.			Mean	Std D.	df	F.	Sig.
	Group 1. n = 7	**Group 2. n = 7**	**Group 3. n = 5**	**Group 1.**	**Group 2.**	**Group 3.**	**Overall**				
Phonological Alliteration Before	**88.57**	**92.86**	**88.00**	**16.76**	**11.13**	**13.04**	**90.00**	**13.33**			
Phonological Alliteration After	**88.57**	**100**	**94.00**	**10.69**	**-**	**13.41**	**94.21**	**10.17**			
Change in Phonological Alliteration	**0.00**	**7.14**	**6.00**	**20.70**	**11.13**	**8.94**	**4.21**	**14.22**	**1**	**0.457**	**N.S.**
Phonological Rhyme Before	**68.23**	**74.15**	**71.43**	**14.67**	**9.06**	**12.14**	**71.42**	**11.56**			
Phonological Rhyme After	**71.42**	**77.55**	**81.90**	**9.53**	**10.18**	**16.97**	**76.72**	**12.21**			
Change in Phonological Rhyme	**3.19**	**3.4**	**10.47**	**9.07**	**8.57**	**7.83**	**5.30**	**8.77**	**1**	**1.342**	**N.S.**

N.B.: Group 1: music intervention treatment only, Group 2: 5-7 weeks of phonological awareness only, Group 3: both music intervention and 5-7 weeks of phonological awareness only.

5.3.14 Analyses including all participants

By restricting the number of phonological awareness treatment sessions to 5-7 weeks, the analysis presented in Table 5.5a/b excluded the participants with weaker decoding skills from Group 3 but not from Group 2. These participants were included in the Time One analysis presented in Table 5.1a/b. In Time 2, participants with weaker decoding skills were given an extended number of phonological awareness training sessions amounting to 10 weeks, in combination with the music intervention. These participants have been included as group 3A and the findings of this analysis, are set out in Table 5.6a/b.

In Table 5.6a/b, findings for the analysis of three groups of participants and five dependent variables are presented. For reasons described earlier regarding the composition of Table 5.5a/b, two multivariate analyses were conducted for the findings presented in Table 5.6a/b. Each MANOVA computed three dependent variables; the least significant dependent variable, reading accuracy was computed in both analyses.

The findings presented in Table 5.6a show a highly significant effect for the rate of reading measure ($p = 0.005$), an effect for reading comprehension ($p = 0.043$). There were no statistically significant effects for reading accuracy.

The findings for rate of reading were statistically significant ($p = .005$). For Group 1 (the music intervention only group) the mean score for rate of reading before treatment was 57.83 and after treatment was 73.31. The rate of reading mean scores for Group 2, (the phonics training only group) were 60.08 before treatment and 65.01 after the treatment. For Group 3A, (both treatments with up to 10 weeks of phonics training) the mean score before treatment was 62.71 and, after treatment, the mean score was 50.76. The rate of reading increased in Group 1 by 15.48 words per minute and in Group 2 by 4.93 words per minute. In Group 3A, a decrease in the mean rate of reading of 11.95 words per minute occurred.

The findings set out in Table 5.6a., show, an effect for the reading comprehension dependent variable ($p = .043$). The mean score for Group 1 before treatment, was 26.79, and after treatment 47.32. For Group 2, the reading comprehension mean was 38.39 before treatment, and after the treatment 37.50. The reading comprehension mean score for Group 3A before treatment was 27.34 and 60.94 after treatment. For Group 1 an increase of 20.53 in the mean score was recorded. Following treatment, a decrease of 0.89 was recorded in the mean score of Group 2. For Group 3A an increase of 33.60 was found in the mean score following treatment. These changes in the mean score are summarised in Fig. 5.6.

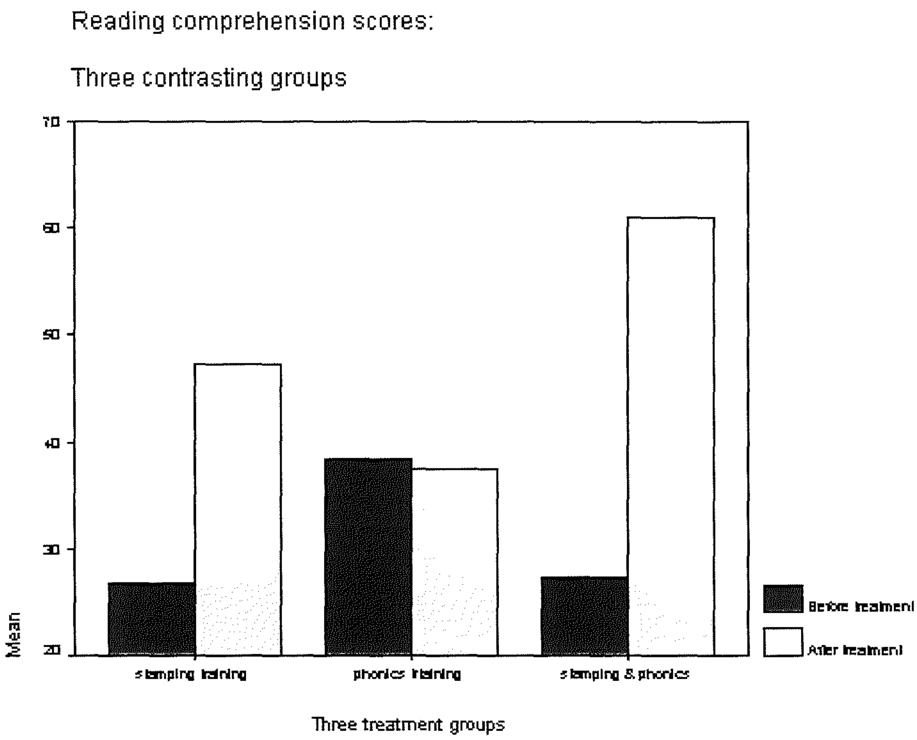
In Table 5.6a a statistically non-significant result was found for the reading accuracy measure. The reading accuracy mean score for Group 1 was 27.08 before treatment and 26.05 after treatment. For Group 2 the before treatment mean score was 58.04 and the after treatment mean score was 57.14. The before treatment mean score for Group 3A was 27.35 and 29.68 following treatment. Group 1 and Group 2 experienced very small decreases in mean change score: 1.03 for Group 1 and 0.9 for Group 2. There was a small increase of 2.33 in the mean change reading accuracy score for Group 3A.

Table 5.6a. Data from Time 1 and Time 2 between three contrasting groups, combining two multivariate analyses of variance.

	Mean			Standard Deviation			Mean	Std D.	df	F.	Sig.
	Group 1. n = 7	**Group 2. n = 7**	**Group 3A. n = 8**	**Group 1.**	**Group 2.**	**Group 3A.**	**Overall**				
Reading Comprehension Before	26.79	38.39	27.34	23.31	25.62	24.08	30.68	24.08			
Reading Comprehension After	47.32	37.50	60.94	22.49	28.87	28.69	49.15	27.50			
Change in Reading Comprehension	20.53	-0.89	33.60	26.12	27.58	23.49	18.47	28.84	1	3.761	.043
Reading Accuracy Before	27.08	58.04	27.35	48.36	16.81	34.54	37.50	36.17			
Reading Accuracy After	26.05	57.14	29.68	42.09	22.94	23.10	37.80	31.40			
Change in Reading Accuracy	-1.03	-0.90	2.33	26.98	20.55	14.45	0.30	20.31	1	0.049	N.S.
Reading Rate Before	57.83	60.08	62.71	24.29	17.71	20.53	60.44	19.83			
Reading Rate After	73.31	65.01	50.76	29.24	27.59	15.37	61.96	24.84			
Change in Rate of Reading	15.48	4.93	-11.95	5.25	20.38	8.46	1.52	16.00	1	7.089	0.005

N.B.: Group 1: music intervention treatment only, Group 2: 5-7 weeks of phonological awareness only, Group 3A: both music intervention and up to 10 weeks of phonological awareness training.

Fig. 5.6: Bar chart illustrating Reading Comprehension scores from Time 1 and Time 2 between three contrasting groups, including participants that received up to 10 weeks of phonics training in the stamping and phonics group.



In Table 5.6b findings recorded for the Alliteration Test (Frederickson et al, 1997), show a statistically non-significant result. The mean score, 88.57, for Group 1 was unchanged following the treatment. For Group 2 the mean score before the treatment was 92.86 and 100 (unanimous) after the treatment. The mean score before treatment for Group 3A was 92.50 and 96.25 following treatment. Differences in the ability of the participants of Group 3A concerning decoding difficulties were reflected by the mean gains in the Alliteration Test: 7.14 by Group 2, and 3.75 by Group 3A. There was no change in the mean score for Group 1.

An effect was found (p = .042) for the Rhyme Test. For Group 1 the mean score before treatment was 68.23 and after treatment 71.42. The mean rhyme score for Group 2 was 74.15 before treatment and 77.55 after treatment. For group 3A, the mean rhyme score was 71.43 before treatment and 85.71 following treatment. Similar gains in rhyme were made in the mean score: 3.19 for Group 1 and 3.4 for Group 2. In Group 3A, a larger increase in the mean rhyme score of 14.28 was recorded.

Table 5.6b. Data from Time 1 and Time 2 between three contrasting groups, combining two multivariate analyses of variance

	Mean			Standard Deviation			Mean	Std D.	df	F.	Sig.
	Group 1. n = 7	**Group 2. n = 7**	**Group 3A. n = 8**	**Group 1.**	**Group 2.**	**Group 3A.**	**Overall**				
Phonological Alliteration Before	**88.57**	**92.86**	**92.50**	**16.76**	**11.13**	**11.65**	**91.36**	**12.83**			
Phonological Alliteration After	**88.57**	**100**	**96.25**	**10.69**	**-**	**10.60**	**95.00**	**9.64**			
Change in Phonological Alliteration	**0.00**	**7.14**	**3.75**	**20.70**	**11.13**	**8.94**	**3.64**	**14.22**	**1**	**.503**	**N.S.**
Phonological Rhyme Before	**68.23**	**74.15**	**71.43**	**14.67**	**9.06**	**11.38**	**71.42**	**11.38**			
Phonological Rhyme After	**71.42**	**77.55**	**85.71**	**9.53**	**10.18**	**14.40**	**78.91**	**12.74**			
Change in Phonological Rhyme	**3.19**	**3.4**	**14.28**	**9.07**	**8.57**	**7.82**	**7.49**	**8.77**	**1**	**3.834**	**.042**

N.B.: Group 1: music intervention treatment only, Group 2: 5-7 weeks of phonological awareness only, Group 3A: both music intervention and up to 10 weeks of phonological awareness training.

5.3.15 Discussion

In the three preliminary and exploratory experiments described in Chapter Four, section 4.5.1, participants with below average reading capabilities were found to have benefited most from the music intervention treatment. The principal aim of conducting Experiment 'D' was to gain further insight into the character of the sample that benefited from the music intervention so that a target population might be defined further. The development of a preliminary understanding of 'timing' as distinct from 'decoding' in the processes that are required of children learning to read, provided a focus for investigating reading behaviour in Experiment 'D'. These issues are explored in Chapter Seven, (Part One) and Chapter Eight (section 8.2.7).

There may be a type of learning difficulty that is specifically 'time' related, affecting fluency and 'timing' processes in reading. The findings of Experiment 'C' suggested that any 'timing' difficulty may be associated with a weak metrical pulse. The orchestration of reading skills involving processes combining working memory, decoding skills and access to schema was suggested in this investigation to depend upon successful 'temporal organisation'. The sample in Experiment 'D' was drawn from participants known to experience difficulties with concentration and reading comprehension, a sample that was considered by deductive reasoning to experience difficulties with 'temporal organisation'.

It transpired that the sample included participants demonstrating high levels of within sample variation. Possible language impairment was shown by poor discrimination between vowel sounds in participant 11, and poor discrimination between consonant sounds in participant 6 found to be present in speech as well as writing and reading. In addition, a short-term auditory memory deficit was shown by difficulty in retaining sounds for comparison in the phonological awareness test; repetition was required (in accordance with the procedure) for several participants. Unlike the mainstream school samples that participated in previous experiments, most participants in Experiment 'D' were unfamiliar with some of the vocabulary that made up the texts in the reading assessment tests of the Neale Analysis of Reading Behaviour (Neale, 1989). It is likely that the characteristics of the individual participants of this sample increased sampling error and to some extent confounded any manifestation of change in 'temporal organisation' in the findings.

The findings in Time One of Experiment 'D' recorded no statistically significant effects in changes in reading behaviour between the two treatment groups. Within sample variation was larger than had been anticipated and the responses of the participants to both of the treatments was slower than expected. However, in the measure of reading comprehension, a statistically significant effect ($p = .034$) was found following Time 2, between the mean change score -0.89 of Group 1 that received 5-7 weeks of phonological awareness treatment and Group 2 received both the music intervention treatment and 5-7 weeks of phonological awareness treatment with a mean change score of 45.31. Again, in reading comprehension a statistically significant effect (p = .046) was found in an analysis between three groups. For Group 1 that received the music intervention treatment only the mean change score was 20.53, whereas Group 2 that participated in 5-7 weeks of phonological awareness only, recorded a mean change score of -0.89. For Group 3 that participated in both the music intervention and 5-7 weeks of phonological awareness, the mean change score was 41.25 in reading comprehension. A third statistically significant effect (p = .043) in the reading comprehension dependent variable occurred between the mean change scores of Group1 and Group 2 as described previously, and the mean change score 33.60 for Group 3A that received up to 10 weeks of the phonological awareness training and the music intervention. These findings suggested that the participants benefited from a combination of the phonological awareness treatment and the music intervention. The gains in reading comprehension also supported similar findings in the three field experiments.

In the analyses between the mean change score of rate of reading between three groups, a statistically significant effect (p = .017) occurred following Time 2. The mean change score in rate of reading was 15.79 words per minute for Group 1 that received the only music intervention treatment. For Group 2 that participated in 5-7 weeks of phonological awareness the mean change score in rate of reading was 5.53 words per minute whereas for Group 3 that received both music intervention and 5-7 weeks of phonological awareness only, the mean change score was decreased by - 13.98 words per minute. Similarly a statistically significant effect (p = .005) occurred in the rate of reading dependent variable in a three group analysis that included Group 3A that received up to 10 weeks phonological awareness training and the music intervention, producing a mean change decrease in score of -11.95 words per minute. A higher level of statistical significance in this latter analysis can be attributed to the lower standard deviation scores for Group 3A rather than larger differences between the mean change scores.

A significant effect (p = .042) also occurred in the phonological discrimination rhyme measure. A mean change score of 3.19 was found for the music intervention group and 3.4 for the group that received 5-7 weeks of phonological awareness training. A dramatic gain in the rhyme mean change score of 14.28 was found for Group 3A that received up to 10 weeks of phonological awareness training combined with the music intervention treatment.

These findings suggested that at the end of Time 2, participants that had received an extended period of phonological awareness training had experienced gains in phonological discrimination; participants that had received an extended period of the music intervention treatment had experienced gains in reading behaviour, particularly reading comprehension. The combination and possible interaction of the two treatments offered to most of the participants in Time 2, arguably would have intensified any benefit of participating in Experiment 'D', but the learning difficulties in evidence for some of the participants were likely to remain unchanged following participation in the combined interventions. The gains in reading behaviour and phonological discrimination were likely to have occurred in spite of the learning difficulties rather than as a result of the learning difficulties having being resolved in any way.

The central issue of change in 'temporal organisation' of the participants was directly addressed by observing their responses to the music intervention during each session across Times 1 and 2. In Time 1 only two participants achieved temporal control and coordination of their actions at the end of the six week period. The remaining four participants of Group 1 received the extended music intervention treatment sessions achieving temporal control and coordination of their actions by the end of the five-week period of Time 2. Of the 5 participants that were new to the music intervention treatment in Time 2, only 2 of these achieved temporal control and coordination of their actions after 5 weeks of treatment sessions. This rate of response to the music intervention was consistent with the response of participants in Group1, indicating that the majority of these participants were slower to learn the music intervention than other sample groups in previous experiments.

A slowness of response was also found in the phonological awareness training intervention. The participants that received the extended phonological awareness treatment sessions, became more confident in decoding and manipulating phonics during the ninth and tenth sessions. The 6 participants that were new to the phonological awareness treatment in Time 2 displayed much within group variation and most of the group lacked confidence in decoding and manipulating phonics at the end of the 5 week period. These observations suggested that most of the participants responded more slowly overall to the treatment sessions than had been anticipated.

An objective for conducting Experiment 'D' was to distinguish characteristics in reading behaviour that may be attributed to 'temporal organisation' following exposure to the music intervention as opposed to reading behaviour that is associated with phonological discrimination. Findings in Experiment 'D' showed low scores in reading accuracy overall. This finding might be influenced by specific difficulties: a lack of auditory acuity, a lack of auditory or visual perception, possibly deficits in auditory or visual short-term memory indicated but not diagnosed by the participants responses to the assessment tests. These difficulties were likely to generate decoding errors in reading accuracy scores although this area was not investigated in this study. Other factors such as a lack of reading practice in word recognition, a lack of familiarity with the vocabulary in the texts may have also contributed to decoding difficulties for the participants in Experiment 'D'. For the purposes of this discussion, all of these factors will be considered under the term 'difficulties with decoding'. The influence of 'timing' upon reading processes is inevitably constrained by 'difficulties with decoding'; these deficits were likely to mask the effect of improved 'timing' in reading processes.

To differentiate between participants it is helpful to distinguish between 'difficulties with decoding' and 'timing' issues in reading. While some individuals in Experiment 'D' that experienced problems with reading have demonstrated gains following participation in the music intervention, this treatment would probably not help those that are already 'temporally integrated', defined as experiencing an internal sense of temporal organisation, coordination and control (see Chapter One, section 1.1.5). The degree of motor coordination in the first music intervention treatment session indicated the presence or absence of overall 'temporal integration'. To summarize the differing profiles of readers, with respect to decoding and 'timing' aspects of reading, it is suggested that four categories of predicted response to the music intervention treatment, are considered as illustrated in fig. 5.8:

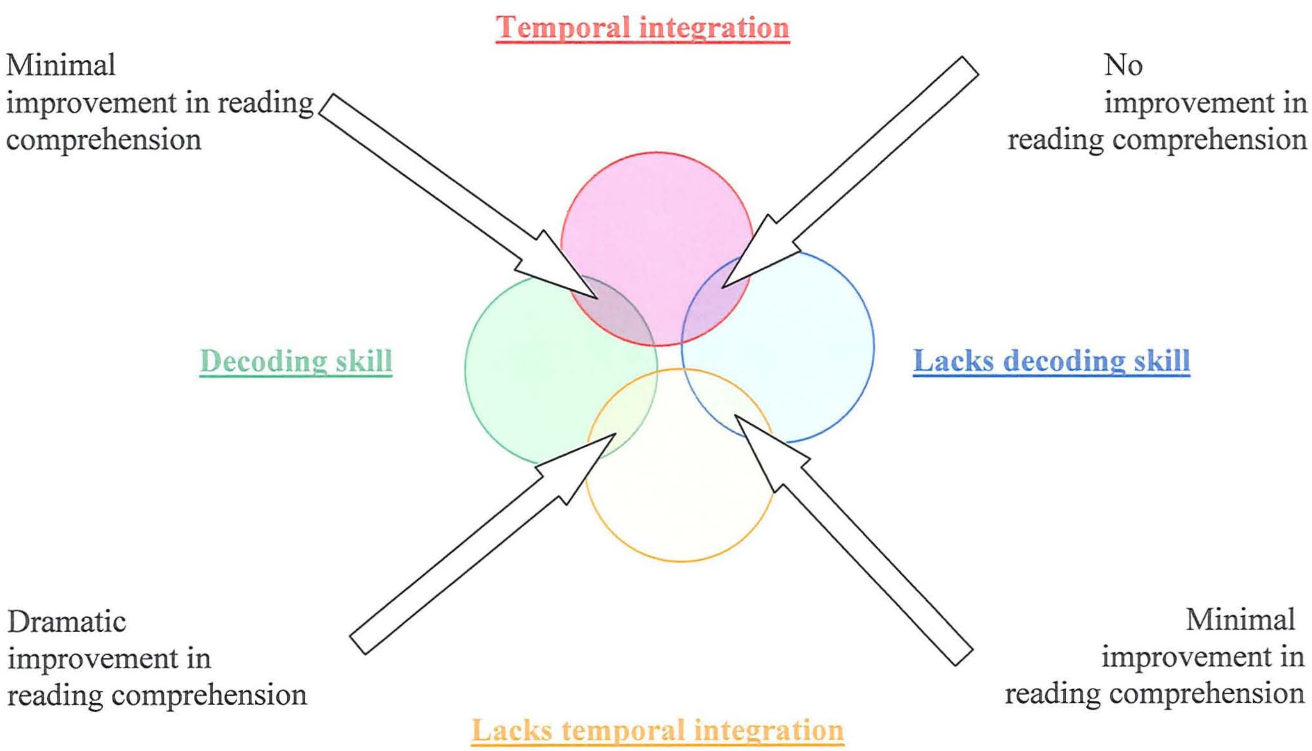
- Presence of 'temporal integration' and decoding skills in which only minimal improvement in reading comprehension will occur,

- Presence of 'temporal integration' and lack of decoding skills in which no improvement in reading comprehension is expected,

- Presence of decoding skills but lack of 'temporal integration' in which a dramatic improvement in reading comprehension is predicted,

- Lack of 'temporal integration' and lack of decoding skills in which the predicted improvement in 'temporal integration' is masked by 'difficulties in decoding'.

Fig.5.8. Categories of differing responses, in reading behaviour, to the music intervention in relation to decoding difficulties and timing difficulties.



The findings from Experiment 'D', comparing two contrasting multi-sensory treatments, suggested that each treatment had a different effect upon the participants. Increases in reading comprehension mean change scores consistently appeared after the participants received the music intervention treatment. Gains in the mean change score for the rhyme measure were found following participation in the phonological awareness treatment. A ceiling effect in the alliteration test is likely to have threatened the internal validity of this measure with an increased likelihood of committing Type II Error (a false negative finding).

Effects were found to be statistically significant when extended periods of treatment had been provided for the participants. Significant effects following the Time Two treatment period indicated that the two contrasting treatments may be combined successfully to achieve considerable gains in the mean change score of the participants' reading behaviour. This combined approach suggested that two independent treatments may be appropriate for tackling two separate problem areas that subsequently contribute to the orchestrated processes that make up reading behaviour.

The participants that may benefit from the music intervention are likely to be children without severe difficulties in decoding skills but who demonstrate a weak sense of metrical pulse. Participants thought not to benefit from the music intervention are those with a confident sense of metrical pulse. In Experiment 'D', the sample group was made up of participants that were weak in their sense of metrical pulse but they also had weakness in phonological discrimination and reading accuracy. These participants were likely to benefit from the music intervention strategy, but any improvement in their 'temporal integration', and 'timing' skills as reflected in their reading behaviour, was likely to be masked by their severe difficulties with decoding.

A trial in two schools

Chapter six

6.1 Introduction

In the three field experiments and the two contrasting multi-sensory treatments experiment, congruent findings were indicated for participants that demonstrated below average capability in reading behaviour. Gains in reading comprehension were found in each experiment, for these participants, following participation in the music intervention. However, the external validity of these findings would be strengthened by increasing the ecological validity of the study and by reducing opportunities for 'experimenter effects'. Therefore, a trial was conducted, to investigate the effectiveness of the music intervention when directed by school staff.

6.2 Method

6.2.1 Access and participating schools

The headteachers of eight middle schools in a large regional town were invited by letter to participate in the research project. The aims, methods, recent findings of the project, and the outline of the proposed six week trial, were outlined in the letter. Two headteachers responded with interest.

The first school, School 'E', in 'special measures', assigned the Music and Art Coordinator, alias Mrs Brown to make all the arrangements for the trial. Mrs Brown, an artist with an interest in music education and three years experience as music coordinator, believes that in art and music, 'you can't do anything wrong; it's always a creation, always special, everything is always improving…'. The music intervention, intrigued Mrs Brown who saw it as a novel means of introducing her pupils to musical notation, improving their rhythm and perhaps interesting the visiting school inspectors.

The second school, School 'F', a denominational school, invited the researcher to an interview with the Headteacher. Two subsequent meetings were organised with the

English Department and the Learning Support Department. The findings of previous experiments indicated to the Headteacher and the Head of the English Department that some children with below average capability reading behaviour had experienced gains in reading scores. The possibility that some of the below average reading attainment pupils in School 'F' might experience similar benefits by participating in the trial, provided the Headteacher and the Head of English with justification for participating in the research.

Two Learning Support Assistants (LSAs) were assigned to direct the music intervention with the school children. Mary (alias), a highly skilled LSA had professional expertise, gathered over 20 years, in the educational support and care of autistic children. Neither LSA had previous knowledge or experience in reading musical notation. The position of the trial, in the setting of the English Department, allowed a realistic exploration of the effectiveness of the music intervention by non-music practitioners.

6.2.2 Preparation and demonstration of the music intervention

Both reliability and validity of the trial were potentially threatened by the possibility of substandard direction of the music intervention. Measures were taken to limit these threats by ensuring a high quality of preparation for the professionals involved. Instructions detailing the format, issues and potential weaknesses of the music intervention were issued to the relevant members of staff in both schools three weeks before the trial began (see Appendix VII).

Two weeks before the trial began, a demonstration of the music intervention was provided in each school. This gave the researcher an opportunity to check that simple but vital equipment such as adjustable music stands were available for the music intervention. In the demonstration session at each school, the relevant staff observed while the researcher directed six children in brief music intervention demonstrations. The staff agreed that the instructions were explicit and that the demonstration had assured them of the simplicity of the intervention. After the demonstration, they were introduced to a data recording pro-forma for use following each session. The purpose of the pro-forma was for registering the participants' names and for recording the position on a chart corresponding with the progress of each participant during each intervention session.

6.2.3 Sampling

In both schools children with below average capability in reading were sampled for participation in the trial. The pupils with below average capability in reading were streamed by School 'E' into a separate class, and were set by School 'F' as a separate English learning group from age 9 years. In School 'E' the sample was drawn from 9 – 10 year olds but in School 'F' the sample was drawn from 10 – 11 year olds. The size of the sample was defined by the researcher as 'at least 12 participants' from each school but consistent with strength in ecological validity, pragmatic issues governed both sample size and the design of the trial.

6.2.4 Experimental designs

A repeated measures design was agreed for both schools. Pre-testing and post-testing dates were arranged in the initial meetings. The sizes of the sample and the question of whether to include a control group remained open until the practical issues surrounding the direction of the music intervention had been resolved.

Design for School 'E'

In School 'E' Mrs Brown revealed that she would not be able to remove small groups of six children from their art or music lessons to participate in the music intervention as she had previously indicated because staff resources were insufficient to guarantee supervision for the remainder of the class. Mrs Brown proposed that the participants performed the music intervention in front of the class as a 'performance' element of the music curriculum.

As a researcher I found this proposal unacceptable. The exclusion of the rest of the class from an intervention that was thought to potentially benefit all of them, was ethically difficult to justify. The potential for humiliation for the small group performing the exercises in front of their peers was a real risk. The validity of the trial would be threatened under such conditions of peer scrutiny. It was decided that the whole class would participate for ethical reasons. This would perhaps strengthen any effect of the music intervention because the sample would be larger and also because the collective impulse generated by stamping within the larger sample might intensify the impact of 'temporal regulation' upon the sample.

The practical considerations of conducting the intervention strategy with the larger sample of 18 were considerable. Threats to internal reliability included,

- Increased difficulty in monitoring individual children's focus on their stamping action,
- Reduced opportunity for providing appropriate support for children that needed extra encouragement,
- Reduced likelihood that the teacher would participate with the children,
- Increased likelihood that the teacher would merely observe the children during the music intervention.

On the positive side, the whole class environment for the music intervention increased the ecological validity of the design, and placed the intervention within the 'performing from music notation' element of Music in the National Curriculum at Key Stage Two. Internal reliability may also have been enhanced by increased anonymity for inhibited participants within the whole class setting. Inhibited children, and those that were experiencing a weak sense of metrical pulse, might have been more likely to develop 'temporal integration' when surrounded by a larger group of participants in the music intervention. A control group was not included in this design but the standardised scores, available in the reading measure (Neale, 1989), provided an alternative method for reliable comparison.

Design for School 'F'

In School 'F' the learning support assistants and the English teacher selected 12 children of 10-11 years of age, from a low ability curriculum English class of 16, for participation in the music intervention. Twelve children were selected on the grounds of 'suitability' and four children were excluded on the grounds of uncooperative behaviour and / or very poor attendance record. This form of selection, based on subjective rather than objective criteria, is fairly typical of the type of decision-making that teachers practise in a real educational setting. Nevertheless, the non-scientific selection of the participants may be considered to weaken the external validity of the design of the trial.

Both learning support assistants agreed to direct the intervention activity as they had seen it demonstrated to them and as outlined in the instructions, detailed in Appendix VII. The twelve participants received the treatment sessions in two groups of six, directed by one of the LSAs in the Learning Support Resource Room, away from peer scrutiny. The four children that were excluded from the intervention activity by the staff at the school were available as a control group which was far from ideal in both its inadequate size and uncharacteristic nature.

The trial in School 'F' demonstrated strong ecological validity as the practice of learning support assistants working with small groups of pupils away from the rest of the class is a highly realistic school situation. The learning support assistants, using the researcher's instructions, were able to direct the music intervention indicating that the music intervention may be considered for use in schools by LSAs. The sessions, directed by either of two LSAs, allowed some variability of approach, rapport and personal style which may have threatened the internal reliability of the trial.

6.2.5 Materials

In both schools, during pre-tests and post-tests, all the participants were administered the Neale Analysis of Reading, Revised Edition (Neale, 1989); for reliability coefficients see Appendix I. The procedure for testing was conducted according to the instructions in the manual. Although parallel texts were available in the Neale, it was decided that the same passages of text would be used for pre-tests and post-tests. After a six-week period, it was unlikely that the participants would remember the details of the text. By using the same text, a clearer comparison between two readings in terms of reading fluency would be demonstrated.

The participants were able to select the most appropriate text for their self-perceived reading capability. Some participants elected to begin at level 1, and read through to level 5. This was costly in time but enabled an accurate reading profile to be obtained in the data collecting process. During the intervention sessions, pieces from 'Stepping Stones' (Colledge & Colledge, 1991) were used, consistent with previous experimental work in this project. A pre-recorded CD of the musical accompaniments was provided for the sessions. At the end of the post-test readings the children were interviewed briefly about their impression of the music intervention and whether they had experienced a change in themselves or in their reading behaviour since starting the music intervention sessions. Following the reading comprehension exercises, the children were asked,

- 'What did they think of the stamping exercises?'
- 'Did they think the exercises would be useful for other children to do?'
- 'Why?'
- 'What sort of changes had they noticed in their own reading?'

6.2.6 Procedure

Participants were pre-tested for reading ability in the week preceding their half-term holiday. Their reading was recorded onto mini-disc for analysis. In the six-week period following the half-term holiday, participants received music intervention treatments of ten minutes duration on a regular basis. The design stipulated that ten sessions would take place during the six week period but in practice the number of sessions that were attempted was actually reduced by at least 50%. Some pupils, frequently absent from school, received only two or three treatment sessions.

In School 'E' the treatment sessions were conducted in the classroom at the start of each curriculum music lesson. The whole class of pupils stood behind their chairs and participated in the exercises facing the overhead projector where the musical notation was displayed. In School 'F' the LSAs extracted six participants from their curriculum English lesson to participate in the treatment exercises in the Learning Support Resources Room.

The levels of participation and progress of the participants were recorded on charts following each session in both schools. In School 'F' the small 'control group', remained in their normal English lesson. Following the intervention period, every participant was post-tested repeating the pre-test texts from the Neale Analysis of Reading (Neale, 1989). Their reading was recorded onto mini-disc for analysis of reading accuracy, reading comprehension and rate of reading.

6.2.7 Analysis

Because of the differing experimental conditions of the schools participating in this trial, the data was not merged to create a larger sample. The data from the trial is presented in two formats: a statistical analysis and a conversion of the data into reading age scores. The statistical analyses (within groups one-way ANOVA) were conducted on SPSS software.

For the presentation of data as reading age scores, the recordings of the children's reading were analysed in accordance with instructions in the manual of the 'Neale Analysis of Reading' (Neale, 1989). The instructions state that for reading accuracy any reading attempt exceeding 16 accuracy errors is excluded from the analysis. This procedure was followed while establishing the reading ages that are set out in Tables 6.2 – 6.5.

Every valid passage of reading that was attempted by the participants was included in the reading age analysis to offer as true a picture of reading age as possible. Some children, particularly boys, declined to read more than 3 passages of text and because of this, the reading age scores may be confounded by the participants' *attitude* to reading rather than remaining an absolute measure of reading ability.

Some children attempted passages of a higher level of difficulty, for the first time, in the post-testing session. The implications of this will be discussed. Disparities in the number of passages read by each participant have not affected the statistical components of the analyses. The data set for the statistical analyses compares the reading scores for texts that were read by each participant in the pre-test *and* the post-test sessions, thereby eliminating bias and improving both internal validity and reliability. By taking this decision, the risk of committing Type II Error (a false negative finding) was increased because data that demonstrated improvements in the participant's reading capabilities was not fully included in the analysis.

6.3.1 Results of the trial in two schools

The changes that took place in reading behaviour during the six-week intervention period in School 'E' and School 'F' are summarised in Table 6.1. following a repeated measures analysis of variance.

In the findings set out in Table 6.1, five of the six measures of reading were found to be significant. In the reading comprehension measure for School 'E' the mean pre-test score was 40.97. The mean post-test score for reading comprehension increased to 57.03 following the intervention treatment giving a mean change score of 16.06. Similarly, the reading comprehension measure mean change score was 13.29 in School 'F' with a pre-test score of 42.58 and post-test reading comprehension score of 55.87 following the intervention treatment. In School 'E' the mean change score in the reading comprehension measure was found to be very highly significant: $p = .000$. Similarly, in School 'F' a highly significant result was found in the mean change score for the reading comprehension measure: $p = .012$.

The mean pre-test score in the reading accuracy measure for School 'E' was 53.82. The mean post-test score increased to 68.99 following the intervention period. The mean change score was 15.17. In School 'F' a similar mean pre-test score for reading accuracy of 52.84 was found. The post-test mean score for reading accuracy increased to 69.07 giving a mean change score of 16.23. For the reading accuracy measure, the mean change score for School 'E' was significant: $p = 0.019$ and the mean change score for reading accuracy in School 'F' was found to be very highly significant: $p = .000$.

In the measure of rate of reading the pre-test mean score was for School 'E' was found top be 56.06 words per minute. Following the intervention treatment, the post-test mean score in rate of reading increased to 72.87 words per minute, giving a mean change score of 16.81 words per minute. In School 'F' the rate of reading mean change was 5.16 words per minute. The pre-test score was 76.98 words per minute and following the intervention period the mean score for rate of reading increased by a small amount to 82.14. In School 'E' the findings for the mean change score in the rate of reading measure were very highly significant: $p = .000$. However the mean change score for the rate of reading measure in School 'F' was not found to be significant.

Table 6.1. Summary of a repeated measures ANOVA including descriptive statistics and critical values of 'F' following an analysis of within subjects (repeated measures).

Within Groups one-way ANOVA								
School 'E', n = 15	**Pre-test scores**		**Post-test scores**					
Reading measure	**Mean**	**Std D**	**Mean**	**Std D.**	**Mean Change**	**df**	**'F'**	**Sig.**
Comprehension	**40.97**	12.22	**57.03**	12.57	**16.06**	14	48.124	**.000**
Accuracy	**53.82**	28.70	**68.99**	14.41	**15.17**	14	7.020	**.019**
Rate	**56.06**	18.29	**72.87**	14.65	**16.81**	14	31.821	**.000**
School 'F', n = 11								
Comprehension	**42.58**	14.53	**55.87**	17.89	**13.29**	10	9.460	**.012**
Accuracy	**52.84**	23.78	**69.07**	24.32	**16.23**	10	29.431	**.000**
Rate	**76.98**	24.38	**82.14**	26.51	**5.16**	10	1.917	**.196**

6.3.2 Reading age scores - School 'E'

The reading ages for the participants from School 'E' are set out in Table 6.2 .

The findings in Table 6.2, show the three different reading measures reflecting reading behaviour within an individual, using reading age scores as a standardised means of comparison. Each set of reading ages constitutes an individual reading profile with relative strengths and weaknesses. In some cases the shape of the reading profile has been retained during the intervention treatment period. This means that the strong and weak aspects of the reading profile have not changed following participation in the music intervention. In other cases, the shape of the reading profile has altered following the intervention period and these alterations may indicate that organizational features of the reading process have changed following participation in the music intervention.

The reading age scores that are set out in Table 6.2 have been converted to reading age change scores; these are set out alongside the views of the participants in Table 6.3 following a brief interview described in section 6.2.5. The findings in Table 6.3 indicate that in most cases gains in reading behaviour were sustained during the six-week intervention period. A gain of six-weeks in reading age may be expected to occur under usual circumstances during that period of time. Since the whole class participated in the music intervention, some of the children were already skilled readers. The findings described here are frequently in excess of the expected gain in reading behaviour. It has been possible to identify the differing responses of the participants as clusters of patterns of reading profile change. Where clusters have been observed, the findings for these participants have been described together.

Table 6. 2: Pre-test and post-test data for School 'E' showing reading ages in years and months from the Neale Analysis of Reading (Revised edition).

Pupil	Reading comprehension		Reading Accuracy		Reading Rate	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
1[1]	9.08	13+	11.05	13+	7.11	9.04
2[2]	7.06	9.05	8.00	9.00	9.06	11.00
3	11.02	11.09	9.10	10.05	9.04	9.09
4	9.05	9.11	8.01	8.07	7.05	7.06
5	7.00	8.00	5.09	6.09	8.01	7.09
6	8.03	11.09	9.06	10.08	8.07	9.09
7	8.10	9.11	9.08	9.07	9.02	10.07
8	8.03	8.07	8.06	9.01	6.05	8.05
9	11.02	11.05	10.02	10.09	9.11	10.11
10	6.07	7.03	7.09	7.06	8.06	10.11
11	7.06	7.00	7.05	7.09	5.03	7.02
12	11.05	11.05	10.11	11.03	8.09	8.08
13	7.09	8.03	8.02	8.05	8.06	10.11
14	6.07	6.04	7.04	7.10	9.06	11.00
15	6.04	7.09	5.11	7.02	5.04	8.01

[1] In the post-tests, pupil 1 felt confident enough to attempt level 6 which she had not read in the pre-tests.
[2] In the post-tests, pupil 2 attempted level 4 which he had not read in the pre-tests.

Cluster 1.

For Pupil 6, Pupil 7 and Pupil 1, increases in reading age of 42 months, 11 months and 36 months were recorded for reading comprehension; gains of 14 months, -1 month, and 24 months in reading accuracy; gains of 14 months, 17 months and 15 months in rate of reading were also found. These participants were aware of changes in their reading behaviour and their remarks indicated that an improvement in reading fluency had been perceived. The pre-test scores indicate that at the time of pre-testing, these participants had strengths in reading accuracy that were not matched in rate of reading or reading comprehension. Following the intervention treatment period, the level achieved in reading comprehension had exceeded the post-test level achieved in reading accuracy. This profile may be indicative of poor 'temporal integration' at the point of pre-testing.

Cluster 2

For Pupil 3 and Pupil 9, gains of 7 months and 3 months in reading comprehension were found; gains of 7 months and 7 months in reading accuracy were found; gains of 5 months and 12 months were found for rate of reading. At the time of pre-testing, these participants were found to have reading comprehension reading age scores 14 months and 10 months in advance of the level expected of a ten-year old child. Levels of reading accuracy and reading rate were commensurate or a little behind of those expected of a ten-year old child. This profile suggests that difficulties with timing were probably not experienced by these participants. In spite of Pupil 3's own admission that he did not enjoy the intervention activity and resisted taking part, changes in post-test reading scores for this participant showed improvements in reading behaviour had taken place.

Cluster 3

For Pupil 4 and Pupil 8, gains of 6 months and 4 months were found for reading comprehension; in reading accuracy gains of 6 months and 7 months were found; in rate of reading, gains of 1 month and 24 months were found. At the time of pre-testing, rate of reading scores for these participants were 31 months and 43 months behind, reading accuracy scores were 23 months and 18 months behind the levels expected for a ten-year old child. Interestingly, Pupil 4 confirmed that she had experienced coordination difficulties when participating in the intervention activity. Pupil 8 reported increased interest in developing her reading capability. It is likely that further exposure to the intervention activity would provide further benefit to the reading behaviour of these participants.

Cluster 4

For Pupil 5 and Pupil 15, gains of 12 months and 17 months were found in reading comprehension; gains of 12 months and 15 months were found in reading accuracy; gains of -4 months and 33 months were found in rate of reading age scores. Pupil 5 reported experiencing a dramatic change in her reading behaviour and in her sense of wellbeing whereas Pupil 15 revealed that he did not enjoy reading. Both participants had lagged behind their peers with reading comprehension age scores that had been found to be 36 and 42 months behind, and their reading accuracy scores had been found 52 months and 49 months behind the level expected of a ten-year old child at the time of pre-testing. While there are similarities between these two participants, Pupil 5 experienced a decline in rate of reading, the strongest score in her reading profile. A decline in rate of reading has mirrored an advance in reading comprehension in previous findings. This finding is discussed in Chapter Eight (sections, 8.2.4; 8.2.7; 8.7.5). Conversely, Pupil 15 experienced an advance in reading age for rate of reading, which was found to be the weakest area of his reading profile in the pre-tests. The changes in reading behaviour sustained during the intervention period may represent a catalyst for reading recovery for these participants.

Cluster 5

For Pupil 10, Pupil 13 and Pupil 14, gains of 8 months, 6 months, and -3 months were found for reading comprehension; gains of -3 months, 3 months and of 6 months were found in reading accuracy; gains of 29 months, 29 months and 18 months were found for rate of reading. The age scores in reading accuracy and reading comprehension show that at the time of pre-testing, reading levels lagged acutely behind those expected for a child of ten years chronological age. The relationships between the scores in the reading profiles did not alter during the intervention treatment period, though the strong local gains in rate of reading for all three reading profiles suggests that further changes within these reading profile may have occurred if more exposure to the intervention treatment had been possible. Interestingly the pattern shown by the reading age profiles is matched by the remarks made by these participants.

Isolated Cases

Gains in reading behaviour were found for Pupil 2 in reading comprehension of 23 months, reading accuracy of 12 months and rate of reading of 18 months. The gains made by this participant brought his reading comprehension age and reading accuracy age considerably closer to the level expected for reading behaviour of a ten-year old child. This participant enjoyed the intervention activity but seemed unaware of the improvement in his reading.

A gain of 23 months was found in the rate of reading measure for Pupil 11 with a gain in reading accuracy of 4 months and a decline in reading comprehension of 6 months. The negative finding for reading comprehension does not conform to the pattern of findings in this research project. The rate of reading age score at the pre-test was 57 months behind the level expected for a child of ten years. Following reluctant participation in the intervention treatment, the relationship of scores in this participant's reading profile altered. With further exposure to the music intervention, it is possible that further benefits to reading behaviour would have been sustained.

A gain in reading accuracy of 4 months, a small decline of 1 month in rate of reading and no change in reading comprehension age were found for Pupil 12. This participant was found to have reading comprehension and accuracy of reading ages 17 months and 11 months ahead of the level expected of a ten-year old child at the time of pre-testing. It appears likely that in these two areas of strength in the reading profile that the participant was already achieving his potential. This participant articulated personal changes during the intervention period indicating that he experienced an increase in his sense of well-being.

Table 6. 3 Changes in reading ages between pre-test and post-test scores in calendar months using standardised data of the Neale Analysis of Reading Ability (Neale, 1989) and set alongside self-perceived changes in reading behaviour for participants from School 'E'

	Change in reading age between pre and post-testing (months)			
Pupil	**Reading Comp-rehension**	**Reading Accuracy**	**Reading Rate**	**Self-perceived change in reading behaviour and comments on the intervention**
1	36+	24	15	It's easier to read harder words now, I'm better at keeping my place. I think stamping is good. It's easier to understand what the words mean
2	23	12	18	Stamping was fun. My reading has stayed the same
3	7	7	5	Stamping is really silly. I tried not to take part
4	6	6	1	My reading is the same but it has got easier a few days ago. Clapping with stamping was hard and then it got easier.
5	12	12	-4	My reading got easier...and stamping: I felt new as if I was just born. I could read more better
6	42	14	14	Reading has got a bit easier, it's flowing better. I feel the same as usual. I enjoy reading. Yes, stamping was helpful but I'm not sure why.
7	11	-1	17	I'm reading more confidently, understanding more.
8	4	7	24	I've become more interested, reading is easier now – there's more point to it. I enjoyed stamping.
9	3	7	12	I can learn new words and read a bit louder. I'm surprised!
10	8	-3	29	I can learn new words. Reading is hard...and easier. I'm still finding the stamping hard to do.
11	-6	4	23	My reading hasn't changed. Stamping was silly. I wish we weren't doing it.
12	0	4	-1	I find reading is easier. I'm understanding more that I read. Stamping is helpful – it's important to do. It makes you feel happier and more together with your body. There's been a gradual change in me.
13	6	3	29	Reading has got better. Words are easier to understand – they have more meaning. I'm reading faster, I'm not enjoying it though. Stamping was enjoyable. It would be helpful for all children.
14	-3	6	18	I have noticed a difference in my reading. It's got harder now – I'm reading a higher level. I'm slower now and understanding words is more difficult. I like reading more – it's fun – it's been more fun since half term. I choose to read harder books now, it's easier to finish books now.
15	17	15	33	Reading has stayed the same. I understand the words a bit better but the meaning is the same as before. I don't like reading. Stamping was alright – maybe it was a waste of time. Stamping was easy.

Comments from Mrs Brown

The verbal feedback from Mrs Brown stated that she firmly believed that the music intervention had 'worked'. She found that the children wanted to 'do it' and described how they would stand behind their chairs waiting for the session to begin without being instructed to. Interestingly, Mrs Brown felt that the musical accompaniment was not necessary and that the group would generate their own collective pulse without a musical accompaniment. The naming of musical notes had gone well and the children had learned to read bass clef notation. Mrs Brown had found that the cumulative approach of beginning with stamping, adding clapping and then chanting had been helpful. She suggested that the music intervention was likely to benefit numeracy skills because of the logic and sequencing tasks embedded in the music intervention. For future implementation, Mrs Brown recommended that sessions of 5 minutes, three times a week would be helpful.

6.3.3 Reading age scores - School 'F'

The reading ages at the time of pre-testing and post-testing for participants from the trial at School 'F' are set out in Table 6. 4.

The findings in Table 6.4 correspond to the presentation of reading age scores for School 'E' set out in Table 6.2. Three sets of reading age describe the three reading measures from the Neale Analysis of Reading Ability (Neale 1989). Examining the data in this way allows composite aspects of individual reading profiles to be compared before and after the intervention treatment. The reading ages that are set out in Table 6.4 have been converted to reading age change scores; these are set out alongside the views of the participants in Table 6.5.

Table 6. 4: The results of reading ages in years and months from Neale Analysis of Reading (Revised edition) for School 'F'.

Pupil	Reading comprehension		Reading Accuracy		Reading Rate	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
1	7.03	7.09	7.03	7.03	10.08	11.03
2	7.00	8.00	9.02	10.05	8.01	8.04
3	7.06	8.07	6.10	7.05	7.08	7.09
4	5.10	7.09	7.10	9.00	9.09	9.02
5	5.03	6.09	5.08	6.03	9.02	7.04
6	6.01	7.00	6.08	7.02	9.06	11.07
7	8.10	9.01	8.08	11.00	10.00	13.00
8	5.10	5.08	7.03	7.08	10.07	11.03
9	8.07	9.05	8.01	9.05	8.04	11.11
10	7.00	7.06	7.05	7.08	9.05	6.09
11[3]	7.06	7.09	10.04	8.01	11.05	13 +

The findings in Table 6.5, similar to Table 6.3, indicate that in many cases, gains in reading behaviour were recorded following the six-week intervention period. A gain of six-weeks in reading age may be anticipated during that period of time. The findings described here are frequently in excess of a six-week gain in age scores for reading behaviour. Where clusters have been observed, the findings for these participants have been described together. Where clusters were not observed, findings are presented as individual cases.

Cluster 1

For Pupil 4, Pupil, 5 and Pupil 10, gains of 23 months, 18 months and 6 months were found in age scores for reading comprehension; gains of 14 months, 7 months and 3 months were found for reading accuracy age scores; negative changes of -5 months, -22 months and -32 months were found for rate of reading age scores. Interestingly, for these

[3] * Pupil 11 declined to read one of the texts in the post-test so her reading accuracy and reading comprehension scores reflect the fact that one test was not attempted. Reading rate is not scored cumulatively unlike accuracy and comprehension.

participants, the age scores for reading comprehension and reading accuracy were found to range between 38 and 69 months behind the expected level for an eleven-year old child at the time of pre-testing. The pre-test reading age scores for rate of reading ranged between 19 and 22 months behind expected levels, making rate of reading a singular strength in the reading profile for this cluster of participants. Following the intervention treatment period, the uneven pattern of reading behaviour in the reading profile of this cluster became less extreme. The post-test scores for reading comprehension and reading accuracy were found to range between 24 and 64 months behind the expected level for an eleven-year old child. The post-test scores for rate of reading ranged between 22 and 51 months behind the expected levels. These findings suggest that the participants made gains in reading comprehension and reading accuracy by reducing their scores in rate of reading, which had not been commensurate with their overall reading profile. This finding is discussed in Chapter Eight (section, 8.7.5).

Cluster 2

For Pupil 7 and Pupil 9, gains of 3 months and 10 months in reading comprehension reading age were found; gains of 28 months and 16 months were found in reading accuracy; gains of 36 months and 44 months were found in rate of reading. Following participation in the intervention treatment, the reading age scores for reading comprehension remained behind the level expected for an eleven-year old child in spite of considerable gains achieved in this six-week period. In reading accuracy, Pupil 7 achieved the reading age commensurate with the level expected of an eleven-year old child following participation in the intervention. Both participants achieved and exceeded the reading level expected of an eleven-year old child in the rate of reading measure following participation in the intervention treatment.

Cluster 3

For Pupil 3 and Pupil 6, similar gains in reading comprehension of 13 months and 11 months were found; similar gains of 7 months and 4 months were found for reading accuracy; dissimilar gains in reading age in rate of reading of 1 month and 25 months were found. While the advances in reading age for these two participants appear to be encouraging, their post-test reading age scores for reading comprehension and reading accuracy ranged from 29 months to 48 months behind the level expected for a child of eleven years.

Isolated Cases

For Pupil 1, a gain of 6 months was found in reading comprehension; for reading accuracy, no change was found, a gain of 7 months was found in the rate of reading measure. The advance in reading age for rate of reading found in the post-tests scores, resulted in this participant achieving the level expected of an eleven-year old child following participation in the intervention sessions in this measure only.

For Pupil 2, a gain of 12 months was found in the reading comprehension measure, a gain of 15 months was found for the reading accuracy measure; the rate of reading measure was found to have advanced by 3 months following participation in the intervention treatment sessions. In this reading profile, unlike others in this sample, the strength in the reading lay in the reading accuracy score, suggesting that decoding was not the principle area of difficulty. Areas of weakness in rate of reading and reading comprehension were found to be 35 months and 48 months behind the level expected of an eleven-year old child at the point of pre-testing. While this profile suggests that a difficulty with 'temporal integration' may persist in spite of participating in the music intervention, this participant had tried to resist participating in the intervention.

Pupil 8, an autistic participant, refused to answer any of the reading comprehension questions in the post-testing session. A negative gain of -2 months was found in reading age score for reading comprehension. For reading accuracy, a gain of 5 months was found; a gain of 8 months was found in reading age for the rate of reading measure.

Pupil 11 read a fewer number of texts in the post-testing session compared with the pre-testing session. For this reason, an imbalance exists within her reading profile. A gain of 3 months was found in reading age for reading comprehension and in rate of reading a ceiling effect was reached as this participant exceeded the level for a child of 13 years. A decline of 27 months in the reading age score for reading accuracy was recorded at the post-testing session.

Table 6. 5 The changes in reading ages that were found between the pre-test and post-test findings are shown in calendar months. They were calculated from the standardised data of the Neale Analysis of Reading Ability (Neale, 1989) and are set alongside self-perceived changes in reading behaviour for the individual participants that took part in the trial at School 'F'.

	Change in reading age between pre and post-testing (months)			
Pupil	**Reading Comp-rehension**	**Reading Accuracy**	**Reading Rate**	**Self-perceived change in reading behaviour and comments on the intervention**
1	6	0	7	I liked stamping but I thought it was a bit babyish.
2	12	15	3	I think stamping is silly. My reading is the same as before.
3	13	7	1	Stamping is quite fun. I can read further and the words have more meaning while I read.
4	23	14	-5	I like reading more now. My reading has slowed down and there's more meaning in the words.
5	18	7	-22	I think my reading is a bit slower now and the words have more meaning. I like reading a lot more now.
6	11	4	25	I don't lose my place so much now. It's easier to join the words. The meaning in the words is the same as before
7	3	28	36	Stamping was silly!
8	-2	5	8	Stamping was silly!
9	10	16	44	Reading is easier now. I have achieved higher reading scores. It's easier to understand reading now.
10	6	3	-32	My reading is the same but I like reading a bit more now as it seems a little easier.
11	3	-27	31+	Declined to comment

Comments from the LSAs

The two Learning Support Assistants found the music intervention very 'hard going' indeed. They reported that the boys in particular had resisted cooperating during the sessions and had been disruptive for some of the time. Some of the children appeared, they thought, to have participated properly. Their overall perception of the music intervention was that it was not valuable. When questioned closely about the difficulties that they experienced in conducting the exercises they reported three main points. The instructions and the demonstration were clear and straightforward to follow. The stamping element of the exercises had been a positive feature of the sessions. The problems had emerged when coordination was required between the stamping, clapping and chanting[4]. The learning support assistants had persevered in spite of the challenging behavioural reaction of the children experiencing difficulties with coordination.

6.4.1 Auditing of the data

The aim of the trial in two schools was to control for 'experimenter effects' in the implementation of the music intervention. An audit of the data provided further safeguards against 'experimenter effects' and bias and strengthened the internal validity of the trial as well as the reliability of the investigation overall. The person appointed to undertake the audit had recently completed an MA in Music Education at the Institute of Education. Her reputation for maintaining meticulous attention to detail, personal integrity and her recent experience as a literacy coordinator in the primary school where she worked, contributed to her suitability as an auditor of the analysis of data in the study.

The auditor was provided with unedited recordings of the complete data set for the trial in two schools and the researcher's own analysis of the readings. This was necessary because the procedure of miscue analysis requires detailed recording of misread words into six different categories of possible error type. The researcher's analysis of the readings provided a useful model for the auditor to work from at the outset. The auditor was instructed to spend about three hours randomly selecting reading samples for analysis. The audit included scores of reading comprehension, rate of reading and reading accuracy for sixteen reading samples. The audited samples were evenly distributed between the two schools and represented pre-tests and post-tests. The findings of three t-tests are set out below.

6.4.2 Results of analyses run on auditor and researcher findings

The three tables set out below give the results of three paired samples t-tests performed on the auditor's findings in comparison with the researcher's findings. The correlation

[4] Challenging behaviour is not uncommon when children realise that their poor coordination, that they have managed to conceal up until that point, has been exposed. This type of situation requires sensitivity, encouragement and reassurance on the part of the group leader.

coefficients in all three tables indicate a highly significant level of correspondence between the auditor and the researcher in each of the three scores of reading behaviour.

Table 6. 6 A paired samples t-test of 16 cases of auditor's findings compared with the corresponding 16 cases from researcher's findings taken from pre-test and post-test reading samples.

Reading scores	Mean		Std. D.		n	df	Corr.	sig
	Aud	Res	Aud	Res				
Comprehension	51.12	51.24	12.97	13.30	16	15	.974	.000
Accuracy	71.36	73.26	20.14	20.57	16	15	.984	.000
Rate	76.93	76.35	19.18	19.11	16	15	.979	.000

Table 6.7 A paired samples t-test of 8 cases of the auditor's findings compared with the corresponding 8 cases from researcher's findings taken from the pre-tests reading samples.

Reading scores	Mean		Std. D.		n	df	Corr.	Sig
	Aud	Res	Aud	Res				
Comprehension	42.86	43.63	11.74	12.91	8	7	.988	.000
Accuracy	70.03	71.36	20.76	21.53	8	7	.987	.000
Rate	68.84	67.98	19.06	18.52	8	7	.998	.000

Table 6. 8 A paired samples t-test of 8 cases of the auditor's findings compared with the corresponding 8 cases from researcher's findings taken from the post-test reading samples.

Reading scores	Mean		Std. D.		n	df	Corr.	sig
	Aud	Res	Aud	Res				
Comprehension	59.38	58.85	8.18	8.96	8	7	.913	.002
Accuracy	72.66	75.16	20.84	20.85	8	7	.983	.000
Rate	85.02	84.73	16.60	16.72	8	7	.943	.000

6.4.3 Audit Summary

The findings of the audit of data suggest that the researcher's reading sample analysis in the trial in two schools is in agreement with the auditor's reading sample analysis. This finding strengthens the internal reliability of the trial in two schools and has positive implications for the overall reliability of the investigation.

6.5 Discussion

Analysis of raw scores from reading comprehension, reading accuracy and rate of reading measures revealed significant effects in gains in reading comprehension and reading accuracy in both schools and in rate of reading in School 'E' only. The findings for this trial demonstrated that the music intervention treatment, when directed by school teaching staff, did improve reading behaviour. Improvements in reading behaviour were found in reading comprehension and reading accuracy in both of the schools that participated in the trial. Statistically significant gains in reading comprehension and reading accuracy scores were found for the 9-10 year olds and the 10 -11 year old school children of below average reading capability. The gains in reading behaviour were achieved following participation in up to 5 sessions of intervention treatment of 10 minutes duration.

An alternative method of presentation for the findings of the trial was achieved through recording changes in reading age scores using the normative data of the Neale Analysis of Reading Ability (Neale, 1989). This data was coupled with the views of the participants on their reading behaviour, collected at post-testing, following participation in the intervention treatment sessions. In many instances the children were aware of an effect taking place in their reading behaviour, and in some cases, they reported experiencing an improvement in their sense of well-being, during the intervention period. Their views reflected changes in reading behaviour, confirmed by empirical measurement of their reading profiles. This co-occurrence strengthens the reliability of the trial findings. Some children, usually boys declared the intervention activity not to their liking and were more likely not to identify improvement in their own reading behaviour. Preliminary clusters of reading profiles emerged from the findings that were drawn from reading ages for each measure. Larger samples are required before any patterns generated by the reading profile clusters might be suitable for qualitative analysis or considered generalisable.

The difference between the rate of reading scores gathered from the two schools may reflect the intensive literacy support teaching that the Year 6 participants from School 'F' had received for one 12 month period prior to this investigation. The Head of English explained that during the previous year, the participants had worked in groups of 6, for four hours, each week. The reading strategies that School 'F' used included Heinemann Literacy World Satellite Programme and the National Literacy Strategy for levels appropriate to 7-9 year old children. In spite of these efforts many of the children, now, 10-11 years old, demonstrated reading ages of 7 and 8 years. The participants from School 'E', a year younger, had not received comparable specialised reading support.

The gains in reading ages in the findings for this trial were considerable for many individual participants. It is possible that these gains may be attributable to 'practice effects' thereby threatening the reliability of the data. The Neale Analysis of Reading Manual, reports that this is unlikely to be the case:

> 'Practice effects of the Neale Analysis – Revised are low, so that children who are re-tested after a short period of time will gain very much the same score as on the first date of testing. The Neale Analysis –Revised is, therefore, particularly useful for re-testing individual children – for example those who have undertaken a special programme of study,' (Neale, 1989, p.36).

The manual offers reassurance that the improvements in reading behaviour found among the participants in these findings were unlikely to be due to 'practice effects'. A mirroring effect between gains in reading comprehension and a decline in the rate of reading occurred among 5 of the participants. Some reading experts (Dowhower, 1987) have found that reading comprehension capability is correlated with reading 'with expression'. Reading 'with expression' is referred to in the manual in association with lower rates of reading:

> 'Rates of reading may also vary with the child's personality or with the style of teaching in the classroom, for example where drama features in the curriculum, oral reading rates may well be lower as children read with more expression,' (Neale, 1989, p.59).

Issues in relation to this type of change in the rate of reading score where a gain in reading comprehension has been recorded are discussed in Chapter Eight (section 8.7.5).

Only four music intervention sessions were delivered to the participants in each school by the school staff. The feedback for the trial was generally more positive from the participants and the classroom music teacher from School 'E', who had experienced the treatment in a whole class setting. The delivery of the treatment in small groups by Learning Support Assistants in School 'F' demonstrated a generally more negative response on the part of the staff and the pupils, though some pupils appreciated a positive effect upon their reading behaviour and had enjoyed the sessions. The negative feedback that was registered by School 'F' serves to strengthen the findings of the trial. The statistically significant findings of the trial occurred in spite of the resistance that the teaching staff endured from the participants and, in spite of the critical attitude that they voiced toward the music intervention.

In conclusion the findings of the trial indicated that the music intervention may be successfully delivered by both classroom music teachers and learning support assistants. It is possible that previous knowledge of musical notation may be a factor in the overall effectiveness of the delivery. It is likely that greater gains in reading, among a larger number of the participants, may have been found in the trial if the required course of 10 sessions had been implemented.

Analysis of reading fluency

Chapter seven

7.1 Introduction

Although previous chapters addressed rhythmic behaviour and reading sub-skills such as phonological discrimination and rate of reading, the temporal organisation of reading behaviour has remained relatively unexplored. During the collection of reading samples for the three field experiments, Experiment 'D' and the trial in two schools, children were sometimes able to decode the words without difficulty yet their decoding capability was not partnered by any detectable interest in their reading.

In spite of adequate decoding and rate of reading for some participants, an absence of phrasing was apparent. The children's dulled voices, absence of shaped phrases, an apparent lack of enjoyment and commitment may well have been attributable to a dislike of reading or even a negative attitude to learning to read. Some children read very quickly using adequate decoding skills and a facile sense of momentum; they frequently stumbled, lost their place on the line or the page, and their performance in the comprehension questions confirmed that they were unaware of any meaning existing within and between the words they had just read.

The relationship between decoding, fluency and comprehension in reading behaviour is not thoroughly explored in the 'Neale Analysis of Reading Ability' (Neale 1989). I decided to construct a measure, 'Analysis of Reading Fluency', that would allow consideration of these types of fluency difficulties as well as to measure and acknowledge characteristics of reading that are exceptionally communicative and fluent.

Part One

<u>Theoretical basis for the 'Analysis of Reading Fluency'</u>

<u>7.1.2 Rationale</u>

During Experiment 'D' and the trial in two schools, pre-test and post-test samples of children's reading behaviour were collected on minidisc for analysis. For this study the 'Neale Analysis of Reading Ability' (Neale,1989) was used to measure rate of reading (words per minute), accuracy of reading (miscue analysis) and reading comprehension. The Neale Analysis, though robust and reliable, provided too blunt a tool for measuring changes in reading fluency. This position has been noted and described by Singleton (2005, p.6), who found that the categories of miscue analysis offered by the Neale were inadequate for assessing the more subtle differences between groups in an investigation into reading behaviour at the syntactic/semantic interface.

Reading difficulties that may be specifically associated with a weak metrical pulse are of particular interest in this chapter. The literature available on timing in neurology links the empirical evidence gleaned from neurological models, neuroimaging and experiments (in time discrimination and performance in timing) to aesthetic timing in the arts such as music and poetry (Wittman and Poppel, 1999). The cognitive perspective co-exists alongside neurology, but also describes temporal regularity and systematic deviations from regularity. While in speech the periodicities are regular, they are not regular enough to be explained by simple binary time structures. Therefore in this chapter, consistent with the terms described by Jones' theory of dynamic attending, temporal organization of speech and the implications for reading behaviour are based on '(a) identifying functional markers, (b) meaningful deviations from characteristic time hierarchies, and (c) temporal phase relations among various kinds of speech time hierarchies,' (Jones and Boltz, 1989, p. 468).

In Chapter Two (section 2.6.2) the review of literature revealed agreement between neurologists that a common temporal window of duration of 3-5 seconds exists (Wittman and Poppel, 1999). This may constitute that which phenomenologists have defined as a sense of the 'present' (Husserl, 1966). Correspondingly, the temporal parameter for the conveyance of meaning in a single line of poetry, and also in a single musical phrase, according to neurological studies is between 3-5 seconds (Turner and Poppel, 1988). Gestalt psychologists refer to 'good continuation' and 'goodness of form'. In temporal terms it is possible that the time window of 3-5 seconds duration may correspond with such gestalt frameworks, by providing both 'good continuation' and 'goodness of form' (Vos, 1973). The Chomskian chunking theory, founded on rules of generative grammar associated with logic and syntax may also apply here if information that is read may be segmented into 'chunks' and thereby assist working memory. Perhaps this mechanism operates within the common window of 3-5 seconds duration, identified for performance (Wingfield and Nolan, 1980) and perception (Szelag et al, 1996; Fraisse, 1978).

Reading specialists Gibson and Levin (1975, p.306) have identified and described a comorbidity between weaknesses in reading comprehension, segmentation, and reading fluency. Helpfully, Gibson and Levin differentiated between readers with adequate decoding skills and inadequate decoding skills. The children that experienced difficulties with decoding were unlikely to be able to understand the text. An observation that an additional process apart from decoding, absent among non-fluent readers, was made by the authors who cited Cromer:

> 'While there are many children who have trouble just identifying words, and thus are bound to be poor at comprehension, there exists a group of children who can identify words well and quickly but still comprehend poorly, apparently because they treat words as single units, unmodified by their context in phrases and clauses' (Cromer 1970).

Non-fluent readers were described by these authors as seemingly unable to use syntax and semantic context in their reading; their reading remained at the word-by-word stage. This position has been more recently described by Oakhill (1993) who attributed the difficulty specifically to 'Reading Comprehension Deficit', outlined earlier in Chapter Five (section 5.2.1). The findings of Gibson and Levin (1975, p.382) also recognised a failure to organise reading material into meaningful units among some readers, who they suggested, had adequate intelligence.

The lack of organisation of words into meaningful units, the absence of phrasing and expression in the voices of the children as they read constituted a reading difficulty that was not measured by the Neale Analysis of Reading Ability except through low reading comprehension scores. A sensitive and comprehensive measure of reading fluency was required for further analysis of 'timing' skills in reading behaviour.

7.1.3 The Development of the 'Analysis of Reading Fluency'

The first step in developing the 'Analysis of Reading Fluency' was to survey the literature in literacy development for similar measures. 'A Fluency Scale', developed 25 years ago for *FACT*: a Multi-Media Reading Programme by Allington & Brown (1979) is reproduced in Table 7.1. In this measure, the researchers distinguished between three types of punctuation: 'internal punctuation', 'external punctuation' and 'terminal punctuation'. The references to punctuation were not explicitly described or detailed so it is possible only to speculate that terminal punctuation may be a full-stop, 'internal punctuation' may be a comma separating phrases or clauses, 'external punctuation' may be a question mark or an exclamation mark. 'A Fluency Scale' traced a cumulative and systematic progression in the development of reading fluency from decoding at an individual word level to a prosodic reading style resembling natural speech in fluency. The administration of the measure was not particularly detailed since internal variation in the reader's performance was not considered; scoring appears not to have been made periodically, but as one overall score.

Table 7.1. A Fluency Scale (Allington, 1983, p.559)

Reader Reads	Score
Word by word	1
Primarily word by word with some 2-3 word phrasing.	2
Primarily by phrases (2-3 words) but sometimes word by word; sometimes gives phrases inadequate stress in relation to syntax.	3
Primarily in phrases with very little word by word reading; sometimes ignores external punctuation; generally reads in a monotone.	4
Primarily in phrases, attending to terminal punctuation; some internal punctuation is ignored; expression is not consistently adequate.	5
In phrases with fluency, using both terminal and internal punctuation provides appropriate semantic and syntactic emphasis for purposes of dramatization; expression approximates normal speech	6

While the Allington & Brown model included the main features constituting reading fluency, its generalist approach provided an overall impression of reading fluency rather than an acutely focused measurement of it.

In reading, the importance of 'providing redundancies' (the tacit cues of prosodic realisation of the text) has been described in Chapter Two (section, 2.11). 'Redundancies' in written language are commonly recognised by reading specialists as being the key to unlocking fluent reading (Fries, 1963, p.130). Many studies agree that a fluent reader is able to spontaneously provide prosodic elements of language such as intonation and appropriate pauses that are not encoded in the graphemes of written language. It is possible that in the Allington and Brown (1979) model, 'internal punctuation' referred to the reader's ability to locate and intone the 'redundancies' in the written form of language. Writers Patel and Peretz (1997, p.194) have noted that in speech, the pattern of fundamental frequency (Fo) over time is an integral part of the organisation and perception of speech. This pattern has been identified by Patel and Peretz (ibid) as 'intonation' rather than 'contour', and has been described as,

> 'marking the boundaries of structural units, distinguishing pragmatic categories of utterance (e.g. statement, question, command), and signalling focus' (Patel and Peretz, 1993, p.194).

Sensitivity to the intonation of phrase contours and phrase boundaries has been established in a number of studies of infant behaviour (Trehub, Trainor and Unyk, 1997; Trevarthen, 1999). Studies of sensitivity to intonation processing of phrase contours and boundaries in later life have raised disagreement as to whether phrase boundary cues are processed by domains that are common or specific to expression through the modes of speech or music. Evidence taken from studies of brain-damaged patients has prompted the development of a modular theory of specificity for musical processing (Peretz and Coltheart, 2003) that accounts for differences in the auditory perceptual processing of speech and music stimuli. Other writers have focused on evidence suggesting that a common system is engaged for processing pitch for both speech and music stimuli

(Semal, Demany, Ueda, and Halle, 1996; Patel, Peretz, Tramo and Labreque, 1998, cited in Jarvinen-Pasley and Heaton, 2005, p.7).

Interestingly, Halliday (1985) has referred to the melodic and expressive elements of speech (prosody) as being closely associated with rhythmic structures. Through a hierarchical system Halliday proposed that in language each semantic structure was closely related to both rhythm and syntax. For Halliday, the syntax determined that the most semantically prominent words were stressed (slightly elongated) and linguistic rhythm was organized around the syntactic arrangement of the stressed words. The predictable, intuitive, predetermined logic of sentence structure implies therefore a predictable, intuitive, predetermined logic of rhythmic patterning. This model is consistent with recent research in the perception and performance of music and language (Patel and Peretz, 1997, p.203) where 'preboundary lengthening' has been confirmed in empirical studies. The intoned contour that frames each unit of semantic meaning was referred to by Halliday (1985, p.295) as, the 'tone group'. The end of a 'tone group', or 'pitch contour', was marked by a slight lengthening of the final phoneme of the phrase for example:

> '^She / packed her / bags //. Then / she left / home //.'
>
> **Key:** / = 'foot', // = 'tonic foot', ^ = a missing syllable or silent beat,
>
> (Halliday, 1985, p. 307).

By incorporating Halliday's systematic approach in the development of the 'Analysis of Reading Fluency', it was possible to identify individual components of reading redundancy that contributed to prosodic qualities, with increasing objectivity, precision and empirical rigour. The rhythmic foot has been described as,

> 'The rhythmic unit of the English language,' (Halliday, 1985, p.295).

This statement provided support for the theoretical model underpinning this study and suggested an opportunity to investigate the model in more depth. In Chapter Two (section 2.5) references to the 'Hierarchy of Knowledge' model (ibid) framed my own suggestion that the rhythmic patterns of Greek metre constituted a temporal form of 'intuitive knowledge'. By including the regular rhythmic foot and other prosodic elements proposed by Halliday (1985) in the 'Analysis of Reading Fluency', it was possible to empirically investigate the rhythmic elements of 'intuitive knowledge' that I suggest are embedded within the 'Hierarchy of Knowledge' theoretical model (ibid).

7.1.4 Reading comprehension

I suggest that a 'timing' deficit may prohibit the intuitive development of prosody and comprehension in reading capability for some school children. A model linking prosody and language, investigating language in terms of its constituent or structural parts rather than focusing on grammatical elements, was proposed by Halliday. The constituents were layered to form a structural texture that is perceived wholly by those using the language.

The structure of meaning in language may, therefore, be accessed through the perception of prosodic patterns that are rhythmically organized around a regular beat. Similarly, Jones proposed that abstract hierarchical time ratios support dynamic attending schemes. Arguably, Halliday's theory links closely to the principles of Jones' Theory of Dynamic Attending. According to Halliday, rhythm and meaning appear to be woven together in a hierarchical arrangement that provides cues and signals for the accurate uptake of the information conveyed through the medium of the language. Although there may be significant differences between languages with regard to the semantic and prosodic pattern correspondence, Halliday (1985, p.292) stated that such correspondence, nevertheless, applied to all languages.

In the present study, only the English language is of interest and will be referred to without comparison to other languages, though it is assumed, on the strength of Halliday's statement, that a parallel case may be made for any language. In English then, the hierarchical organization of prosodic speech has been described from the top-down as the 'tone-group' followed by a 'foot' which is, further broken down into 'syllables'.
The 'tone-group' was defined as a melodic cluster of sounds or phonemes that together formed the 'information unit' (Halliday, ibid.). The end of a 'tone-group' was delineated by a pause or by a lengthened final syllable (Halliday, ibid.) also identified by Chomsky (1965, p.230). An information unit or 'tone-group' carried information that was already known or information that was new. With respect to the content, the first syllable of the

'tone-group' sets the melodic character of the whole 'tone-group'; this was likely to rise, to fall, or to combine rising and falling intonation (Halliday, 1985, p.296).

The model put forward by Halliday, (ibid.) detailed that within a 'tone-group' are rhythmic feet. The 'foot' organized a number of syllables into rhythmic patterns but not into information units. There was no semantic quality associated with this rhythmic patterning process except that 'tone-groups' were structured around the rhythmic patterning and phonological structuring by the 'descending foot'.

The 'syllable' was the smallest unit in the hierarchy and the speaker conveyed the character of a syllable's relative position in the rhythm or melody of speech through its duration and the quantity of air pressure used to produce the syllable. For example the word 'mother' is composed of two syllables. The first syllable is longer than the second and the air pressure in the first syllable decreases into the second syllable. Generally, native speakers of English, according to Halliday (1985, p.293), grouped longer syllables at regular intervals and organised rhythmic feet into approximately equal lengths.

The relationships between words that provide meaningful and syntactic relations are conveyed through prosodic speech as we have seen in the explanations provided here by Halliday, (1985) and in Chapter Five (section 5.2.1) by Neisser (1967); Staines (1999); Schreiber, (1980). As indicated by Halliday (ibid), information units tend to provide a context of background or 'given' information before a unit of 'new' information is disclosed. Carroll (1972) offered a general definition, linking semantic knowledge to schema theory.

> 'The total meaning of an utterance has to do with the relation of a sentence or discourse to its total context' (Carroll, 1972, p.12, cited Gibson and Levin, 1976, p. 400),

whereas a more function oriented approach is addressed by Simmons,

> 'A semantic structure is a system of ambiguous representations of meaning interconnected by logical relations' (Simmons, 1972, p.72, cited Gibson and Levin, 1976, p. 400).

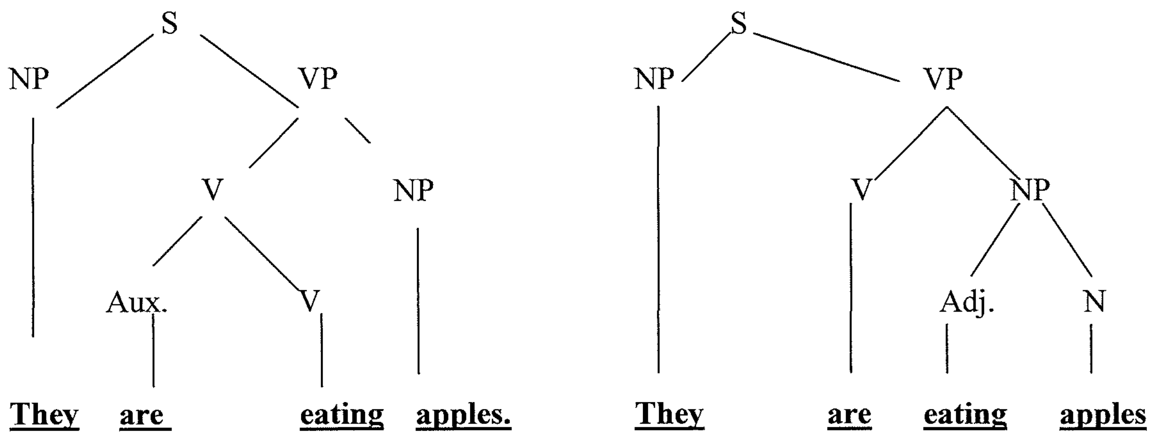
These approaches are, integrated by Chafe's compelling solution, neatly uniting meaning with function,

> 'A semantic unit consists essentially of a verb and one or more nouns standing in some relation to the verb' (Chafe,1972, p.41, cited Gibson and Levin, 1976, p. 400).

If we consider these three definitions while making an interpretation of the following sentence, 'They are eating apples', (Neisser, 1967, p.256-257), we find that the ambiguity of the meaning of this sentence highlights the necessity to be somewhat cautious in approach when defining the concept of a 'semantic unit'. In this case, all three definitions provide an elegant and accommodating framework for the somewhat mercurial character of the 'semantic unit'. The example has been analysed in two ways producing two equally likely interpretations of the sentence, (Neisser, 1967, p.256-257).

Fig. 7.1 A discussion of 'Phrase Markers' (Neisser,1967, p.256-257).

<u>Key:</u> S = Sentence, NP = Noun Phrase, VP = Verb Phrase, N = Noun, V = Verb, Adj. = Adjective, Aux. = Auxiliary



Consistent with definitions of the 'semantic unit' provided by Simmons (1972) and Chafe (1972), a degree of ambiguity surrounds the grammatically logical structure of the 'semantic unit'.

Ambiguity, a characteristic feature of the perception of written language, may have played a part in prompting Goodman (1967) to propose a theory of reading entitled, the 'Psycholinguistic Guessing Game'. In this theory, Goodman (1967) embraced the issue of ambiguity as its defining and legitimizing feature. In agreement with Goodman (ibid.), it is argued here that the concept of ambiguity in language, parallels that of 'inference' in comprehension and juxtaposes processes of thought with processes of language. Both inference and ambiguity imply the necessity for contextual knowledge and prior knowledge, but also, a sense of intuitive empathy with the 'on-going' progression of the discourse. Yet in spite of 'on-going' intuitive processing, Goodman suggested that the reader may disregarded much of the content while constructing their own conceptual hypothesis of the discourse:

> 'Reading is a selective process. It involves potential use of available minimal language cues selected from perceptual input on the basis of the reader's expectations. As this partial information is processed, tentative decisions are made to be confirmed, rejected or refined as reading progresses....Efficient reading does not result from precise perception and identification of all elements, but from skill in selecting the fewest, most productive cues necessary to produce guesses that are right first time. The ability to anticipate that which has not been seen, of course is vital in reading, just as the ability to anticipate that which has not been heard is vital in listening.' (Goodman, 1967, p.127)

Critics of the Goodman theory (Gibson and Levin, 1975, p.450-451) have argued that the approach is too non specific, too general and therefore difficult to check. They have expressed concern that the predictions, supposedly made and checked by the reader, may be located in either the general context, the meaning of words, in preceding grammatical structures or in sounds, and have criticized Goodman for not specifying in his theory how the processes of predicting and checking unfolds.

If we accept that an intuitive system is likely to fuel the process of segmentation hypothesis generation and confirmation within the processes of language perception and comprehension, then the mechanism that determines *selection* as described by Goodman, (1967, p.127) immediately claims interest and justifies examination. This process, described in the 'Analysis by Synthesis Model', (Halle and Stevens 1964, cited, Levin and Gibson, 1975, p. 450) has been defined by Neisser (1967, p.194) as a process in which intuition and hypothesis formation are combined, compatible with Goodman's proposed 'Psycholinguistic Guessing Game' (ibid.):

> 'one makes a hypothesis about the original message, applies rules to determine what the input would be like if the hypothesis were true, and checks to see whether the input is really like that', (Neisser, 1967, p.194).

It seems that in the 'Analysis by Synthesis Model' (Halle and Stevens, 1964) like the Goodman model, (1967), a hierarchical structure of semantic units, assists the perception of meaning both in listening *and* in producing speech.

> 'If the speaker can select the units to be synthesized, from phonemes to the whole message, then he can reverse the process and use the mechanism to understand messages. The speaker apparently uses various-sized hierarchically organized units in parallel, but is concerned mainly with 'holistic, gross properties of the input' and makes use of contextual information' (Neisser, 1967, p.195).

The selection processes that enable comprehension are therefore likely to require tacit cues that are more precise and salient than the logical structures between verbs and nouns typically organized in parallel with a grammatical framework. The reversibility of the process is consistent with the findings of Trevarthen & Aitken (1994) and Trevarthen, (1999) where the framework of the Intrinsic Motive Formation characterized the temporal aspects of the exchange of both *speech and perception of language* in social interactions. A possible transitional function between the logic of grammatical relations and semantic comprehension that dispelled syntactical ambiguity was suggested by Neisser who proposed 'phrase-markers'(fig. 7.1) as internal rhythmic structures that group successive words into segments. He explained that the ambiguity of a sentence might be resolved through suitable stress and changes of rhythm that denote the meaning that is implicit in the content of the sentence.

Syntax formation assists the generation of segmentation hypotheses, which in turn may correspond with the proposed hierarchical system of semantic hypotheses. It is possible that this process is entirely involuntary. The spontaneous activation of an intuitive system of grammar rules may automatically correspond with control of the selection of function words and other prosodic cues; as we have seen this intuitive process begins with the recognition of prosodic contour in infants (Trevarthen, 1999).

The same position appears to have been reached by Chafe (1972) who imposed 'constraints' upon reading mechanisms so that the process of 'selection' was achieved by means of elimination on the part of the reader. The position Chafe (1972) assumed was concerned primarily with syntax in prosody, particularly concerning function words as noun-verb structures:

> 'What lies behind universal constraints on the co-occurrence of semantic units' is 'the nature of the knowledge which all human beings share' (Chafe, 1972, p.83, cited Gibson and Levin, 1976, p.400).

Chafe has offered a concept of universal intuitive knowledge as the process aligning co-occurring semantic units. Like Goodman (ibid.), Chafe appears to suggest that intuitive grammatical rules fuse the connections between semantic items and therefore provide the means for making and checking predictions or semantic hypotheses. In addition he has stated:

> 'My assumption will be that the total human conceptual universe is dichotomized initially into two major areas. One the area of the verb, embraces states, conditions, qualities and events; the other, the area of the noun, embraces 'things' (both physical objects and reified abstractions) (Chafe, 1972, p.93, cited Gibson and Levin, 1976, p.400).

The claim that Chafe made in this statement is relevant because he has proposed a *binary* system for the operation of intuitive knowledge, which seems entirely plausible. A binary system would naturally correspond to the syntactical arrangement of *subject and predicate,* the most universal, generative form of prosodic cue for generating segmentation hypotheses.

It is possible to conclude from the literature on prosody and linguistic structures considered here, that a number of universal processes are orchestrated during fluent, prosodic reading or speech. I suggest that the processes proposed by the theorists cited here, form a nested hierarchical arrangement with corresponding rhythmic frequencies contributing to the syntactic order and semantic organization of the language, whether spoken or orthographic.

7.1.5 Analysing reading fluency – a behavioural approach

When attempting to measure fluency and prosody in reading within a realistic experimental setting, it is likely that external variables will impact upon the reader's performance or perception. External variables may be accommodated when describing reading behaviour if these have been anticipated in the design of the measure. The variation in reading performance described by Chittenden, Salinger and Bussis (2001, p.75) suggested that any measure of reading fluency is likely to assess qualities of reading that were possibly quite fragile and mercurial in character. The authors attributed the instability of the quality of reading fluency to a number of possible factors:

- Fatigue: sustained as a child approaches their limit for a reading session; weariness in their voice and slippage in control of text may occur,
- Interest: invented words and phrases may appear in reading due to involvement in the text,
- Confusion: structural confusion may be sustained over a couple of sentences if punctuation is not observed (Chittenden, Salinger and Bussis, 2001, p.81).

These insights indicated that maintaining the 'orchestration process' required for fluent reading involves engagement in a considerably demanding cognitive process until fluency is securely established. It seemed prudent to factor these behavioural observations into the development of the 'Analysis of Reading Fluency'. If an individual reading sample is analysed on a sentence-by-sentence basis, then any variation in the performance due to interest, fatigue or confusion may be recorded at the point at which the disturbance occurs. Similarly, whole sentences that are read fluently can be scored as such.

In addition to the model of reading fluency developed by Allington & Brown (1979) and the linguistic models of fluency and prosody described earlier, other references to fluency, relevant to this work are found in the Associated Board of the Royal Schools of Music Assessment Criteria, see Appendix VIII.

The main elements considered in the assessment of fluency in musical performance are the degree of continuity, the maintenance of a steady metrical pulse and tempo (pace), the organisation of the sounds into phrases, musical expression imparted through tonal control and shaping of the phrases (Taylor, 2005). The quality of the performance in terms of fluency and expression described by these criteria translated naturally into levels of expression and fluency in reading. Aptly, issues surrounding rhythmic components of a performance have more prominence in musical criteria than presented by the Allington & Brown (1979) model. The 'Analysis of Reading Fluency', was developed by drawing on all of the models described above, and is set out in Table 7.2.

The 'Analysis of Reading Fluency', was developed primarily by drawing on the theories of Neisser (1967) and Halliday (1985) which explored rhythm in language as a means of organization that served the syntactic and semantic processing of language. Neisser (1967) described linguistic structures in terms of phrase boundaries which occurred somewhat irregularly but nevertheless periodically in a stream of language. In musical structures, phrase boundaries are often regular and are more predictable than those of language. In the development of the 'Analysis of Fluency', it has been assumed that the rhythm of phrase boundaries in language, the deep structures, referred to by Chomsky (1965) and the binary system of subject and predicate described by Chafe (1970) function in a universal system that underpins language processing. Superimposed upon these deep structures, with their associated phrase boundary rhythms, Halliday's description of the metrical properties of language were assumed to provide the fundamental regularity of audible rhythmic qualities in language.

The 'presence of the regular, rhythmic foot' refers to the regular unit of pedalian rhythm of the English language referred to by Halliday (1985). The 'presence of the regular, rhythmic foot' is the pivotal element in the 'Analysis of Reading Fluency' because the regular rhythmic foot arguably represents a hypothetical threshold in the development of reading fluency. This assertion is made following observations drawn from repeated listening to the reading samples collected during this research. Four phases of reading fluency are proposed and described here.

Level 4 'Pre-rhythm'

The least fluent phase, 'Level 4' was observed when the 'regular, rhythmic foot' was not present in the reader's voice; instability, disorder and disinterest characterised reading samples that were assigned to 'Level 4', described as 'pre-rhythm'. When the 'rhythmic foot' was observed in the reader's voice, it appeared intermittently rather than with regularity. Generally, a reading sample scored as 'Level 4', was proposed to correspond with a poor level of 'temporal integration' or a severe reading decoding difficulty. The transition from 'Level 4' to 'Level 3' is illustrated on CD Track 4 where an increase in the 'presence of the regular rhythmic foot' can be heard in the second reading sample following participation in the trial of the music intervention (described in Chapter Six).

Level 3, 'Pre-phrasing'

Observations of reading fluency at 'Level 3' identified a clear sense of continuity and were noticeably more temporally controlled than observations of the reading fluency of 'Level 4'. 'Level 3' describes a reading style identified as 'pre-phrasing' because in keeping with Halliday (1985) a 'pedalian' style of rhythm in reading was observed. However, the universal system of deep structures described in relation to Neisser's theory, was not implied by reading fluency at this level. Reading samples identified as belonging in the 'Level 3' area may require a model of fluent reading to gain further improvement, similar to the repeated reading programme described by Dowhower (1987) and discussed in Chapter Five (section 5.2.2). An example of reading fluency at this level is provided by CD Track 2. The two reading samples on CD Track 2 show the increased regularity of the rhythmic foot, characterising 'Level 3' and the decline of the monotone at the end of Experiment 'D'.

Level 2, 'Phrasing'

In 'Level 2' the proposed system of deep structures interspersed by phrase boundaries and the metrical aspects of the 'regular rhythmic foot' were assumed to have achieved some form of interaction. Words of the text became linked together through the process of segmentation into information units. In keeping with Neisser's (1967) theory, the observed segmentation process was arguably underpinned by the organisation of phrase boundary structures. The reading samples were observed to form phrases with syntactic structures, automatically acquiring definition in the reader's voice as subject and predicate. A reading style observed and identified as appropriate to 'Level 2' enabled the reader to experience *text as language* and this phase has been accordingly been described as 'phrasing'. Observations of reading samples that settled into the 'Level 2' area were likely to correspond with comprehension of the text because the presence of phrasing indicated that the semantic-syntactic interface had been engaged during reading. The division between 'Level 2' and 'Level 3' was observed to be subtle, as children may rapidly and naturally progress from demonstrating the 'presence of the regular rhythmic foot' in their reading behaviour to demonstrating 'phrasing' in their reading behaviour. Progress from 'Level 3' to 'Level 2' is illustrated on CD Track 3 with a clear increase in phrasing and interest in the text observable in the reader's voice following participation in the trial (described in Chapter Six).

Level 1, 'Fluency'

Few of the participants were observed to read with sufficient fluency to be considered expressive readers, but 'Level 1', 'fluency', details the qualities that would be present in expressive reading. At this level, it is suggested that the style of reading would no longer consist of a process of transmission through language, but a process of transaction through language where the reader's own socio-cultural experiences would assist the reading process. An interest in the content of the text would indicate activation of the reader's schema, and tonal inflection. Recognition of logical sequences would be stimulated in response to the information with which the reader was interacting. Readings in which isolated sentences (in a mostly 'Level 2' profile) were observed to be assessed as 'Level 1' demonstrated communicative qualities, with natural and expressive use made of the prosodic elements of language. It is speculated that readers at 'Level 1' would experience an interaction with the text that engaged their natural curiosity and qualities such as momentum and motivation would therefore be in evidence. It is likely that reading fluency at 'Level 1' would enable the reader to answer inferential questions about the text. Inferential questions[1] occur increasingly in SATS at the end of Key-Stage Two (for age 10 – 11 year olds) requiring the pupil to supply answers that involve conjecture and prediction based on the successful integration of their own general knowledge (schema) with the information supplied by the text.

Summary

The 'Analysis of Reading Fluency' was time consuming to administer. A high level of auditory discrimination was required of the analyst, as multiple items were recorded in a single sentence. By utilising voice-sampling techniques to create prosody audio templates, time saving digital software might be developed in the future. In observations of reading samples collected in this research, fluency levels appeared to be established cumulatively.

The cumulative development of reading fluency observed from the reading samples available in this project suggested some resonance with the cumulative structure of the 'Hierarchy of Knowledge' model of knowledge acquisition. The theoretical argument underpinning the 'Analysis of Reading Fluency' proposed that the 'presence of a regular rhythmic foot' corresponded with 'intuitive knowledge' acquisition. Similarly, it is proposed that the 'presence of subject and predicate' corresponded with a binary system

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[1] [1] Inferential questions rely on the pupil being able to access the appropriate schema before they can formulate an appropriate answer. Social and cultural differences between pupils suggest that inferential questions might disadvantage some children who may lack the appropriate schema for social or cultural reasons.

of noun and verb described by Chafe (ibid) and binary features of the 'Theory of Succession' (Husserl, ibid); both are arguably representative of 'conceptual knowledge' acquisition.

Table 7.2. Analysis of Reading Fluency

Sentence	1	2	3	4	5	6	7	8	9	10	11	12
Level 1: Fluency												
Systems of Key												
Logical sequences												
Functional words												
Inflectional endings												
Confident												
Sensitive to mood												
Communicative												
Pace reflects mood												
Level 2: Phrasing												
Subject and predicate												
Tone group as information unit												
Pitch contour over tone group												
Tonic prominence on tonic foot or tonic syllable												
Sustained pace												
Level 3: Pre-phrasing												
Reasonable continuity												
Overall security in decoding												
Prompt recovery from slips												
Presence of regular rhythmic foot												
Delineation of sentences												
Level 4: Pre-rhythm												
Poor recovery from slips												
Lack of continuity												
Loses place on the page												
Monotone												
Inappropriate use of stress and pause												

Part Two

7.2 Pilot Study of 'Analysis of Reading Fluency'

7.2.1 Introduction

A pilot study of the 'Analysis of Reading Fluency' was conducted using the reading samples collected in the 'two contrasting multi-sensory treatments experiment', (Experiment 'D'). The design of Experiment 'D' required that digital recordings of the participants' reading behaviour were collected on mini-disc at three points in time:

- Pre-tests in October
- Mid-tests in January
- Post-tests in February.

At these three testing points, data was collected using the 'Neale Analysis of Reading' (1989). All the participants were tested at the reading level appropriate to their reading ability. The findings of the pilot study are set out in Appendix X.

7.2.2 Method

The mini-disc recordings were digitally transferred from the mini-disc recorder to a laptop computer using a 'Jack-to-Jack' cable. Using 'Cool Edit' software, which produces, files and edits digital audio data, it was possible to work on small areas of the samples using the Cool Edit programme. This software enabled the analysis of the recordings on a sentence-by-sentence basis while observing the wave formations produced by the participants' reading samples. The procedure for the 'Analysis of Reading Fluency' involved listening to each reading sample three times. During the first listening inappropriate pauses and sentence delineation were recorded. On the second listening an analysis of appropriate and inappropriate vocal stresses was made. The third listening involved analysing individual sentences and recording the remaining items of the 'Analysis of Reading Fluency' column by column. The number of scores in each fluency level were totalled for later comparison.

Part Three

7.3 'Analysis of Reading Fluency' in school trials

7.3.1 Introduction

Following the pilot study, it was decided that the 'Analysis of Reading Fluency' would be applied to the reading samples collected during the trials in School 'E' and School 'F'. The procedures of data collection and analysis for the 'Analysis of Reading Fluency', adopted for the pilot study, were followed for the reading samples derived from School 'E' and School 'F'.

The findings of the 'Analysis of Reading Fluency' for School 'E' and School 'F', indicated that the salient items: 'presence of subject and predicate', 'presence of pitch contour over the tone group' and 'presence of a regular rhythmic foot' were reliable indicators of changes in reading fluency from the samples collected during the trial phase of this research project at the two schools.

7.3.2 School 'E' - Results

Consistent with the pilot study of the 'Analysis of Reading Fluency', a demonstration of the level of sensitivity and appropriateness of the measure is provided. The main objective of Table 7.3 is to illustrating the changes in reading fluency for individual participants by setting out pre-test and post-test scores rather than simply presenting the descriptive statistics. The 'salient items' listed in Table 7.3 have been selected from the overall findings as the items in which the participants' reading behaviour profiles were found to change following participation in the intervention. Descriptive statistics and statistical analysis of the data are summarised later in this chapter (see Table 7.13, section 7.3.6). For ease of comparison, and consistency with the procedure adopted in compiling the corresponding data for the pilot study (See Appendix X, Table 1) all the scores for each item have been converted to percentages.

Table 7.3: Findings of the Analysis of Reading Fluency for School 'E'. Scores are measured as percentages of the text in which the salient items were recorded.

School 'E'	Presence of subject and predicate		Presence of pitch contour over the tone group		Presence of a Regular Rhythmic Foot	
Pupil	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
1	0	37.50	0	75.00	75.00	100.00
2	66.66	87.50	11.11	75.00	44.44	87.50
3	100.00	100.00	87.50	62.50	25.00	62.50
4	66.66	88.88	22.22	55.55	77.77	100.00
5	11.11	55.55	11.11	33.33	11.11	66.66
6	25.00	87.50	0	50.00	50.00	100.00
7	75.00	87.50	37.50	50.00	50.00	100.00
8	33.33	66.66	16.66	50.00	50.00	83.33
9	50.00	87.50	37.50	75.00	37.50	87.50
10	44.44	55.55	22.22	0	55.55	66.66
11	0	11.11	0	0	0	33.33
12	0	37.50	0	25.00	75.00	75.00
13	50.00	100.00	12.50	77.77	100.00	100.00
14	50.00	83.33	16.66	33.33	50.00	83.33
15	0	0	0	0	0	33.33

7.3.3 Implications for Participant Clusters from School 'E'

While it was appropriate to consider the piloted findings of the 'Analysis of Reading Fluency' from Experiment 'D' in terms of participant groups and contrasting treatments, the findings of the 'Analysis of Reading Fluency' from the trial in two schools did not correspond with experimental groupings of participants. Only repeated measures, within group contrasts were appropriate for consideration here. 'Eyeballing' of the data in Table

7.3 and Table 6.1, suggested clustering of some elements of prosodic reading and scores from the Neale Analysis for some participants.

An exploration of the possibility of clustered responses to the music intervention within the sample from School 'E' was made and the findings are set out in Tables 7.4- 7.8.

School 'E', Cluster 1

In Table 7.4 (see CD Track 3) dramatic gains that were recorded in reading age change scores for reading comprehension, (36+, 42 and 11 months respectively) reading accuracy (24, 14 and -1 months respectively) and rate of reading (15, 14 and 17 months respectively) following participation in the music intervention, were partnered by moderate and strong gains in the 'Analysis of Reading Fluency' scores. In particular, the 3 participants in Cluster 1 demonstrated 'presence of a regular rhythmic foot' in all sentences (100% end scores) in their reading behaviour at the time of post-testing.

Table 7.4 Change scores for School E, Cluster 1

Cluster 1	**Change scores in reading age (months)**			**Change scores for presence of 'Analysis of reading fluency' items (percentages)**		
Participant	**Reading comprehension**	**Reading Accuracy**	**Reading Rate**	**Subject and predicate**	**Pitch contour over the tone group**	**Regular rhythmic foot**
1	36	24	15	37.50	75.00	25.00
6	42	14	14	62.50	50.00	50.00
7	11	-1	17	12.50	12.50	50.00

School 'E' Cluster 2

In Table 7.5, mostly modest gains were found in reading comprehension (7 and 3 months respectively), reading accuracy (both gained 7 months) and rate of reading (5 and 12 months respectively) for this cluster following participation in the music intervention. The 'Analysis of Reading Fluency' scores demonstrated mixed responses in each salient item, but these participants did not achieve 'presence of a regular rhythmic foot' in all sentences at the time of post-testing (62.50 and 87.50 % end scores). This finding implies that further exposure to the music intervention may have benefited this cluster.

Table 7.5 Change scores for School 'E', Cluster 2

Cluster 2	Change scores in reading age (months)			Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	Reading comprehension	Reading Accuracy	Reading Rate	Subject and predicate	Pitch contour over the tone group	Regular rhythmic foot
3	7	7	5	0	-25.00	37.50
9	3	7	12	37.50	62.50	50.00

School 'E' Cluster 3

In Table 7.6 mostly modest gains in reading comprehension (6 and 4 months respectively) and reading accuracy (6 and 7 months) were matched by modest improvements in reading fluency following participation in the music intervention. High scores (100 and 83.33 end scores) were achieved in 'presence of a regular rhythmic foot' particularly by participant 4 who achieved this item in all sentences read at the time of post-testing.

Table 7.6 School 'E', Cluster 3

Cluster 3	Change scores in reading age (months)			Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	Reading comprehension	Reading Accuracy	Reading Rate	Subject and predicate	Pitch contour over the tone group	Regular rhythmic foot
4	6	6	1	22.22	33.33	22.22
8	4	7	24	33.33	33.33	33.33

School 'E' Cluster 4

At the time of pre-testing, this cluster achieved reading age scores that were approximately 3 years behind their chronological age and were outliers in the distribution of scores for the whole sample. This finding matched the 'Analysis of Reading Fluency' scores at the time of pre-testing. Moderate improvements in reading fluency were found in each salient item for participant 5, but in 'presence of a regular rhythmic foot' only, for participant 15 (see CD Track 4).

Table 7.7 School 'E', Cluster 4

Cluster 4	Change scores in reading age (months)			Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	Reading comprehension	Reading Accuracy	Reading Rate	Subject and predicate	Pitch contour over the tone group	Regular rhythmic foot
5	12	12	-4	44.44	22.22	55.55
15	17	15	33	0	0	33.33

School 'E' Cluster 5

For these participants, presented in Table 7.8, gains in reading comprehension (8, 6 and -3 months respectively) and reading accuracy (-3, 3 and 6 months respectively) were moderate, while gains in rate of reading were dramatic (29, 29 and 18 months respectively) following participation in the music intervention. Scores from the 'Analysis of Reading Fluency' demonstrated that participant 13 achieved dramatic gains in 'presence of subject and predicate' and 'presence of pitch contour over the tone group'; he also achieved 'presence of a regular rhythmic foot' (100% total score) in all sentences in the pre-test and maintained this level in the post-test. Participant 10 achieved very small gains (11.11) in two salient items and a moderate decline (-22.22) in one salient item. Participant 14 achieved moderate gains (33.33, 17.67 and 33.33 respectively) in each salient item. In spite of similar scores in the 'Analysis of Reading Fluency' pre-test, indicated by italics in Table 7.8, the participants in this cluster demonstrated dissimilar reading fluency post-test responses following participation in the music intervention.

Table 7.8 School 'E', Cluster 5

Cluster 5	Change scores in reading age (months) *Pre-test reading age: years and months*						Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	Reading Comprehension		Reading Accuracy		Reading Rate		Subject and predicate	Pitch contour over the tone group	Regular rhythmic foot
10	8	*6.07*	-3	*7.09*	29	*8.06*	11.11	-22.22	11.11
13	6	*7.09*	3	*8.02*	29	*8.02*	50.00	62.50	0.00
14	-3	*6.07*	6	*7.04*	18	*7.04*	33.33	17.67	33.33

Summary

The data for the sample from School 'E' has been interpreted in participant 'clusters'. This approach has been applied to explore patterns of response suggested by the pre-test reading profiles of these participants, and by changes in reading behaviour found following participation in the trial. The participant clusters highlighted similarities in reading behaviour within the clusters and contrasting reading behaviour profiles between the clusters. Using this approach it was possible to suggest that while any effect of the music intervention on temporal organisation varied between participant clusters, patterns of response were found within most participant clusters.

The reading behaviour of the participants generally improved and the data shows that the most dramatic gains were for participants that achieved 'presence of a regular rhythmic foot' in all sentences read at the post-test. More modest improvements in overall reading behaviour were found for participants that demonstrated 'presence of a regular rhythmic foot' in a lower proportion of sentences read. These descriptions suggest support for the correlations conducted in the pilot study for the 'Analysis of Reading Fluency' and also suggest that some participants, responding more slowly to the music intervention than others, would benefit from further exposure to the music intervention.

7.3.4 School 'F'- results

The salient items from the 'Analysis of Reading Fluency' for School 'F are presented in Table 7.9. For ease of comparison, and consistency with the procedure adopted in compiling Table 1 of Appendix X, and Table 7.3, all the scores for each item have been converted to percentages. Descriptive statistics and statistical analysis of the data are summarised later in this chapter (see Table 7.13, section 7.3.6). Each of the salient items, are positive indicators of emergent prosodic reading.

Table 7.9: Findings of the Analysis of Reading Fluency for School 'F'. Scores are measured as percentages of the text in which the salient items were recorded.

School 'F'	Presence of subject and predicate		Presence of pitch contour over the tone group		Presence of a Regular Rhythmic Foot	
Pupil	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**
1	11.11	66.66	55.55	66.66	100	88.88
2	0	0	12.50	62.50	75.00	87.50
3	0	55.55	33.33	44.44	55.55	77.77
4	0	0	0	66.66	44.44	100.00
5	0	0	0	75.00	0	100.00
6	0	0	0	75.00	0	75.00
7	0	77.77	100.00	88.88	100.00	100.00
8	42.86	50.00	85.71	83.33	100.00	100.00
9	0	0	0	87.50	75.00	87.50
10	0	0	16.66	50.00	33.33	75.00
11	22.22	66.66	77.77	100.00	88.88	100.00

Consistent with the decision to form participant clusters for the sample from School 'E', the data for School 'F' was treated in the same manner. The participant clusters for School 'F' are set out in Tables 7.10- 7.12.

7.3.5 Implications for Participant Clusters from School 'F'

School 'F' Cluster 1

Similar gains in reading fluency, were found for these participants following participation in the music intervention. No gains were found for the three participants in 'presence of subject and predicate'. Dramatic gains were found for participants 4 (66.66) and 5 (75.00) and a moderate gain was found for participant 10 (34.34) in 'presence of pitch contour over the tone group'. Participants 4 and 5 achieved dramatic gains in 'presence of a rhythmic foot' (55.56 and 100 respectively) with all sentences at the time of post-testing (100 % end scores). Participant 10 achieved a moderate gain (41.67) and a moderate final score (75.00) in this item.

Table 7.10 School 'F' Cluster 1

Cluster 1	Change scores in reading age (months)			Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	**Reading comprehension**	**Reading Accuracy**	**Reading Rate**	**Subject and predicate**	**Pitch contour over the tone group**	**Regular rhythmic foot**
4	23	14	-5	0	66.66	55.56
5	18	7	1	0	75.00	100.00
10	6	3	31+	0	34.34	41.67

School 'F' Cluster 2

Table 7.11 shows that for these participants, gains in reading comprehension (3 and 10 months respectively) were moderate, while gains in reading accuracy (28 and 16 months respectively) and rate of reading (36 and 34 months respectively) were dramatic following participation in the music intervention. Scores from the 'Analysis of Reading Fluency' demonstrated that participant 7 achieved dramatic gains in 'presence of subject and predicate' (77.77) and participant 9 achieved dramatic gains (87.50) in 'presence of pitch contour over the tone group'. Participant 7 achieved 'presence of a regular rhythmic foot' in all sentences in the pre-test and maintained this level in the post-test (100%). Participant 9 achieved a small gain (12.50) in 'presence of a rhythmic foot' but a high end score of 87.50. Participant 9 achieved no gain in 'presence of subject and predicate' and participant 7 demonstrated a moderate decline (-11.12) in presence of 'pitch contour over the tone group'. Positive responses to the music intervention were suggested by these reading scores.

Table 7.11 School 'F' Cluster 2

Cluster 2	Change scores in reading age (months)			Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	Reading comprehension	Reading Accuracy	Reading Rate	Subject and predicate	Pitch contour over the tone group	Regular rhythmic foot
7	3	28	36	77.77	-11.12	0
9	10	16	34	0	87.50	12.50

School 'F', Cluster 3

In Table 7.12 the dissimilar pattern of response of rate of reading following participation in the music intervention for these participants is suggested by their reading fluency scores. In rate of reading, participant 3 gained 1 month, which is appropriate for the period of time between the pre-test and post-test dates. Participant 6 gained 25 months in his rate of reading score following participation in the music intervention. For participant 6 dramatic gains in 'presence of a rhythmic foot' (75.00) and 'presence of pitch contour over the tone group' (75.00) were found. A dramatic gain for participant 3 was found in 'presence of subject and predicate' (55.55). No gain was found for participant 6 in 'presence of subject and predicate'. A small gain was found for participant 3 in 'presence of pitch contour over the tone group' and in 'presence of a regular rhythmic foot'. The high end scores in 'presence of a regular rhythmic foot' 77.77 and 75.00 respectively were thought to correspond with gains in reading comprehension. The reading behaviour end scores indicated that these participants remained behind their peers in reading age. The findings suggested that these participants would benefit from extended participation in the music intervention.

Table 7.12 School 'F' Cluster 3

Cluster 3	Change scores in reading age (months)			Change scores for presence of 'Analysis of reading fluency' items (percentages)		
Participant	Reading comprehension	Reading Accuracy	Reading Rate	Subject and predicate	Pitch contour over the tone group	Regular rhythmic foot
3	13	7	1	55.55	11.11	22.22
6	11	4	25	0.00	75.00	75.00

Summary

The three participant clusters showed three separate outcomes. The changes in reading behaviour of cluster 1 suggested that temporal organisation had been quite dramatically improved, while the changes for cluster 2 suggested that an enhancement of previously well ordered temporal organisation had taken place. The changes in reading behaviour for cluster 3 suggested that the participants would benefit from further exposure to the music intervention since some gain was recorded but there was room for further improvement. Overall, data from the participant clusters suggested that changes in 'presence of a regular rhythmic foot' and reading comprehension change scores co-varied, and supported correlations found in the pilot study.

7.3.6 Results of ANOVA – Schools 'E' and 'F'

An exploration into the frequencies and distribution of the salient items from the 'Analysis of Reading Fluency' was conducted. From each of the two sets of 'Analysis of Reading Fluency' data, baseline measures were available; analysis by ANOVA was appropriate. The findings are described here and summarised in Table 7.13.

Significant Effects

The findings of analyses demonstrated significant effects for the three salient items in both School 'E' and School 'F' between pre-test and post-test mean scores for participants in the music intervention trial in two schools.

In 'presence of a regular rhythmic foot' in School 'E', the mean pre-test score was 46.76 and the mean post-test score was 87.89 with a very highly significant effect ($p < .001$). A statistically significant effect ($p = 0.02$) was found in School 'F' for the same item where the mean pre-test score was 60.35 and the mean post-test score was 88.63.

In the item, 'presence of subject and predicate' a very high statistically significant effect was found ($p < .001$) in School 'E'. The mean scores were 38.15 in the pre-test and 65.83

in the post-test. In School ‘F’ the mean pre-test score was 6.93 and the mean post-test score was 28.79. A statistically significant effect ($p = .036$) was found for School ‘F’.

A high statistically significant effect was found ($p = .005$) in both schools for the item, ‘presence of pitch contour over the tone group’. In School ‘E’, the pre-test mean score was 18.33; the post-test mean score was 44.17. Higher scores were found overall for School ‘F’, the mean pre-test score was 34.68 and the post-test mean score was 68.18.

The pre-test mean scores in Table 7.13 are baseline measures taken before the music intervention sessions began. The post-test mean scores were recorded after 5 weeks of music intervention sessions. The statistically significant effects confirm that following participation in the music intervention, improvements in reading fluency have been recorded. These findings have been recorded under trial conditions rather than under experimental conditions.

Table 7.13. Summary of a within groups one-way ANOVA including descriptive statistics and critical values of 'F' following an analysis of within subjects differences between pre-tests and post-tests of salient items of the 'Analysis of Reading Fluency'. Results, in percentages, are listed separately for School 'E' and School 'F'

Within Groups one-way ANOVA									
School 'E', n = 15	**Pre-test scores**		**Post-test scores**		**Change Scores**		**Overall**		
Reading measure	**Mean**	**StdD.**	**Mean**	**Std D.**	**Mean**	**StdD.**	**df**	**'F'**	**Sig.**
Presence of a regular rhythmic foot	46.76	28.93	87.89	22.02	32.13	17.61	14	49.91	.000
Presence of subject and predicate	38.15	31.64	65.83	31.67	27.68	18.30	14	34.325	.000
Presence of pitch contour over the tone group	18.33	22.95	44.17	28.03	25.83	30.19	14	10.99	.005
School 'F', n = 11									
Presence of a regular rhythmic foot	60.35	38.43	88.63	13.16	28.28	33.94	10	7.637	.020
Presence of subject and predicate	6.93	13.88	28.79	33.77	21.86	29.98	10	5.847	.036
Presence of pitch contour over the tone group	34.68	38.46	68.18	20.47	33.49	31.30	10	12.598	.005

A Pearson correlation was conducted on the combined change scores of School 'E' and School 'F'. A moderate positive correlation was found between change in reading comprehension and change in 'presence of a regular rhythmical foot', ($r = .548$; $p < .01$). This finding is similar to the finding from Pearson correlation in the pilot study in which end scores were analysed.

7.3.7 Discussion

In the development of the 'Analysis of Reading Fluency', an aesthetic quality of 'timing' was suggested as a possible mode of regulation and organization of reading processes that contribute to reading fluency. 'Timing' in reading is considered to be an important factor for the 'appropriate use of stress and pause' and the 'sentence delineation' in reading. More telling though is the part played by the item, 'presence of a regular rhythmic foot'. In the pilot study this item was found to correlate strongly at the 5% statistically significant level with the reading comprehension mean end scores. The salience of the 'regular rhythmic foot' as the 'rhythmic unit of the English language' (Halliday, ibid) was explored in the pilot study through correlations.

The 'Analysis of Reading Fluency' has no standardised normative data; correlations and ANOVA suggest validity and reliability for this measure. The findings of the correlation effects in the pilot study were confirmed by a highly statistically significant correlation between change scores in reading comprehension and change scores in 'presence of a regular rhythmic foot' for the combined change scores of School 'E' and School 'F'. Implications for the influence of temporal organisation in reading fluency are suggested by the cohesive feature of this item in the 'Analysis of Reading Fluency' and in Halliday's theory.

Following participation in the music intervention, statistically significant effects were found in reading fluency for participants from both schools that were involved in the trial. Under trial conditions, statistically significant gains were found in salient items of the 'Analysis of Reading Fluency': 'presence of subject and predicate', 'presence of pitch contour over the tone group' and 'presence of a regular rhythmic foot'. These findings suggest that reading fluency is improved following participation in the music intervention when the intervention is directed by school teaching staff.

Varying responses from participants in School 'E' and School 'F' were found in the 'Analysis of Reading Fluency' scores following participation in the music intervention. In Chapter Six (section 6.3) participant clusters were identified according to similar responses to the music intervention and also according to reading age score profiles established at the time of pre-testing. Following the application of the 'Analysis of Reading Fluency' on the data from School 'E' and School 'F' it was possible to describe the participant clusters according to reading behaviour in the salient items: 'presence of subject and predicate', 'presence of pitch contour over the tone group' and 'presence of a regular, rhythmic foot'. In some cases similar patterns were reported between gains in reading fluency and gains in reading age scores derived from the items in the Neale Analysis of Reading Ability (Neale, 1989). In many cases, it was thought that further exposure to the music intervention would have offered further benefit to reading behaviour.

7.3.8 Summary

The aim of developing the 'Analysis of Reading Fluency' was to investigate an organisational aspect of reading behaviour that was not measured by the 'Neale Analysis of Reading Ability' (Neale 1989). While decoding difficulties were deliberately not addressed by the 'Analysis of Reading Fluency', various factors that are recognised in the literature as salient to 'timing' in language production and perception were explored.

In a small scale research project with very small samples, any qualitative type of analysis suggested by the preliminary clustering of participants is unrealistic. Nevertheless, the clustering of participants did highlight the correspondence of the 'regular rhythmic foot' with 'change in reading comprehension' for many participants. This pattern has been independently confirmed by correlation effects in the data of Experiment 'D' and the trial in two schools.

Different levels in the 'Analysis of Reading Fluency' were appropriate to different samples. In the pilot study, the sample from Experiment 'D' was measured by the items that characterised 'Level 3' and 'Level 4', whereas the samples from the trial in two schools settled into 'Level 2' and 'Level 3' of the 'Analysis of Reading Fluency'. These differences might indicate a degree of precision the measure appeared to provide.

The levels of reading fluency, measured by the 'Analysis of Reading Fluency' appeared to correspond with ability in reading comprehension. This finding therefore also suggested support for the prediction that the cumulative structure of the 'Hierarchy of Knowledge' model of knowledge acquisition and the cumulative structure of 'Analysis of Reading Fluency' may correspond if the 'presence of a regular rhythmic foot' represented an organisational aspect of 'intuitive knowledge' acquisition and the 'presence of subject and predicate' corresponded with a binary system of noun and verb described by Chafe (ibid) and binary features of the 'Theory of Dynamic Attending' Jones and Boltz (1989) as factors of an organisational aspect of 'conceptual knowledge' acquisition.

Conclusions

Chapter eight

In this investigation into the effect of a music intervention on reading behaviour, children were engaged in stamping, clapping and chanting, while reading aloud letter the names of simple musical notation. Taking account of the substantial effort required by participation in the music intervention and the external regulating timekeeper that maintained the cohesion and synchronicity of the activity, this intervention may be described as a multi-sensory entrainment activity.

8.1.1 Research Questions that were addressed in this study:

- Where pupils are experiencing difficulty with metre and reading fluency, can metrical stamping, clapping and chanting, while reading music notation, improve temporal organisation? This question is addressed in sections 8.2.5, 8.2.6, 8.2.7.
- Which children in particular might be most likely to benefit from this intervention treatment? This question is addressed in 8.2.7 and 8.3.6.

The following sections summarise the data in relation to these two questions in a stratified approach that is outlined in section 8.1.2.

8.1.2 Organisation of findings of this research project

The findings of this project are summarised in three stages. First, an outline of the statistical analyses will describe how the empirical findings appear to have established a consistent pattern of improvement in reading behaviour following participation in the music intervention. Secondly, the pilot findings from Experiment 'D', and findings of the trial phase of this project will be interpreted using the 'Analysis of Reading Fluency' as the frame of reference. Thirdly, the findings will be described in the context of the theoretical framework outlined in Chapter Two. This stratified approach will lead into a discussion about temporal organisation as 'temporal regulation' and 'temporal integration'.

8.2 Empirical Findings

Following a pilot study, three field experiments were set up in three schools in regional urban areas. The aim of these preliminary experiments was to explore whether any effects on reading behaviour occurred following participation in the music intervention and to outline the nature of the effects. In each experiment, a mixed experimental design was adopted. A range of pre-test and post-test measurements described reading behaviours, rhythmic discrimination abilities, physical balance and movement control for the intervention and control groups. A randomly selected sample of approximately 24 pupils (aged 8-10 years) from the mainstream school population was studied in each of the three schools.

8.2.1 Findings from Experiment 'A'

In Experiment 'A' several measures were used: rhythmic discrimination (Seashore, Lewis, Saetveit, 1939), reading behaviour, using The Neale Analysis of Reading Ability (Neale, 1989), and fine and gross movement control and balance, using the Movement ABC (Henderson & Sugden, 1992).

In the first analysis, a statistically significant main effect ($p = 0.012$) for the music intervention group in the change in rhythmic discrimination scores was found. Overall, the mean changes were 8.75 for the intervention group and 0.00 for the control group.

Two significant interaction effects were found favouring the music intervention group for change in reading comprehension scores. An interaction effect occurred between the independent variables of group and ability in rhythmic discrimination ($p < .001$). The mean changes were 32.5 for the intervention group and -1.56 for the control group that had scored above 66% in the pre-test for rhythmic discrimination but were below the mean pre-test score in reading comprehension. A second interaction effect in change in reading comprehension occurred between the independent variables of group and ability in reading comprehension (p = .011). The mean changes were 41.07 in the intervention group and 12.5 in the control group.

An interesting finding concerning fine motor control emerged. A significant interaction effect (p = .027) between the independent variables of group and ability in reading comprehension and ability in rhythmic discrimination was found for the cutting out an elephant measure favouring the lower capability participants of the music intervention group. The mean changes were 9.0 in the intervention group and 2.0 in the control group for the participants that had scored below the ability thresholds in both rhythmic discrimination and reading comprehension pre-tests. Although a significant interaction effect for the intervention group was recorded in the change in cutting out an elephant measure, changes in other measures of movement and control were not recorded in the post-tests. Following Experiment 'A' the testing of gross and fine movement control ceased.

The design and sample size of Experiment 'A' was replicated in Experiment 'B'. The age of the sample was adjusted from a 9-10 year olds to a 8-9 year old cohort to avoid the threat of a possible ceiling effect in the 'Rhythm Test' (Seashore, Lewis, Saetveit, 1939).

8.2.2 Findings from Experiment 'B'

A significant main effect (p = .012) occurred in the change scores in reading comprehension favouring the music intervention group. The mean changes were 18.75 for the music intervention group and 7.50 for the controls.

Further analysis yielded a significant interaction effect (p = .007) for the change scores in reading comprehension, between the independent variables of group and ability in reading accuracy, favouring the below average capability participants in the music intervention group. The mean changes were 30.0 in the intervention group and 6.25 in the control group.

Interestingly, for the music intervention group, a tendency for a decrease in the change scores in rate of reading was found among participants with pre-test rhythmic discrimination scores above the 24th percentile. A tendency for an increase in the change scores in rate of reading was found among participants with pre-test rhythmic discrimination scores below the 24th percentile. These findings produced an intriguing pattern and a statistically significant interaction effect ($p = .006$) for change in rate of reading between group and ability in rhythmic discrimination. The mean changes were 7.8 for the intervention group and 1.33 for the control group.

A significant interaction effect ($p = .02$) was also found, for the change scores in rhythmic discrimination, between the independent variables of group and ability in rhythmic discrimination, favouring the sector of the music intervention group scoring below the 24th percentile in rhythmic discrimination. The mean changes were 19.33 in the intervention group and 7.78 in the control group.

8.2.3 Findings for Experiment 'C'

In Experiment 'C', the third and final exploratory field experiment, an additional test of rhythmic performance, 'Clapping a Metrical Pulse', was added to the range of measures. In Experiment 'B', pre-test scores in rhythmic discrimination and ability in the rhythmic performance aspect of the music intervention did not always correspond. Some children, proficient in the rhythmic discrimination measure, were not proficient in rhythmic performance elements of the music intervention. Other children, competent in rhythmic performance elements of the music intervention, were not competent in the rhythmic discrimination measure.

Consistent with the findings of Experiments 'B', a significant main effect ($p = .006$) was found for the music intervention group in the change scores in reading comprehension. The mean changes were 21.15 for the intervention group, -1.04 for the control group.

Further analysis provided evidence of two significant interaction effects. A multivariate ANOVA was conducted with the between-factor group, and the within-factors, ability in rhythmic performance and ability in reading comprehension. The significant interaction effect (p = .031) was found for an individual change score in reading comprehension. The mean changes were 100.00 in the intervention group and 12.50 in the control group. The pre-test profile of the participants concerned consisted of a weak sense of metrical pulse in the rhythmic performance measure and below average capability in reading comprehension.

A second significant interaction effect (p = .025) was found in the reading accuracy measure favouring the participants of the intervention group that displayed a weak sense of metrical pulse in rhythmic performance in the pre-test. The mean changes were 15.63 for the intervention group and -16.50 for the control group.

Discrepancies were found between abilities recorded in rhythmic discrimination and rhythmic performance in Experiment 'C'.
From the total sample of 25 children in Experiment 'C', 9 children were unable to clap a metrical pulse to a piece of music. Surprisingly, 6 of those 9 children, scored higher than average in the rhythmic discrimination test. An illustration of the before and after contrast in reading behaviour for a participant that began the music intervention with a weak sense of metrical pulse but developed a stronger sense of metrical pulse during participation in the music intervention, is demonstrated on Track One of the enclosed compact disc. The scores in the rhythmic performance measure for the control group participants were unchanged at the time of post-testing.

Summary

The findings from the three field experiments consistently indicated statistically significant changes in reading behaviour for below average capability readers following participation in the music intervention. These findings supported the researcher's teaching experiences described in Chapter One.

8.2.4 Findings for Experiment 'D'

For Experiment 'D' a new approach to sampling was adopted. The sample for the 'two multi-sensory treatment experiment' (Experiment 'D') consisted entirely of participants from a population that were identified by their school as having difficulties with reading fluency, or reading comprehension. The two treatments offered in Experiment 'D' were: Treatment 1, the music intervention, Treatment 2, phonics training that involved flashcards and word building exercises.

There were no statistically significant findings at the end of the first treatment period. When data from the first and second treatment periods were combined, the participants were differentiated according to the number of weeks of exposure to phonics training they had received. The findings of the 'two multi-sensory treatments experiment' (Experiment 'D') detailed below, supported the findings of the three field experiments.

In Experiment 'D', a statistically significant effect ($p = .034$) was found for change scores in the reading comprehension measure. In this analysis all participants had been exposed to 5-7 weeks of phonics training, the statistically significant effect was found to favour the participants that had received the music intervention in combination with 5-7 weeks of phonics training over the course of the two treatment periods. The difference in the reading comprehension mean change score for the phonics treatment group was -0.79 whereas the reading comprehension mean change score for the group that received the music intervention and phonics was 45.31. No statistically significant effects were found for phonological discrimination, rate of reading, or accuracy of reading.

In further analysis, a comparison of three groups of participants was made. The three groups consisted of: the participants that had received the music intervention only, the participants that received the 5-7 weeks of the phonics training only, and the participants that received 5-7 weeks of the phonics training combined with the music intervention.

Statistically significant main effects in the reading comprehension measure ($p = .046$) and the rate of reading measure ($p = .017$) were found for the participants that received phonics training combined with the music intervention. The participants that received phonics training and the music intervention in combination, recorded a mean decrease in rate of reading of -13.8 words per minute. The participants that were exposed to only one type of treatment recorded an increase in rate of reading. The participants that received the music intervention only, had a mean increased rate of reading of 15.79 words per minute; the participants that received the phonics treatment had an increased mean rate of reading of 5.53 words per minute. Mean changes in reading comprehension were, 20.53 for the group that received the music intervention only, -.89 for the group that received 5-7 weeks of phonics training only, 41.25 for the group that received 5-7 weeks of phonics training and the music intervention. The statistically significant main effects that were found for rate of reading and reading comprehension for the participants that received the phonics training combined with the music intervention appeared to indicate that a decrease in rate of reading accompanied a gain in reading comprehension. This finding is consistent with a similar finding in Experiment 'B'.

In the final analysis for Experiment 'D', three groups were compared. The three participants that received up to 10 weeks of phonics training were included. The additional participants in this analysis had experienced particular difficulties with phonological awareness and had previously developed a dislike of reading.

A statistically significant effect ($p = .043$) was found in the reading comprehension measure for the group that received both the phonics intervention (for up to 10 weeks) combined with the music intervention. A reading comprehension mean change score of 33.60 was recorded for the group that received the music intervention and up to 10 weeks of phonological awareness training. For the group that received the music intervention only, the mean change score was 20.53. The group that received 5-7 weeks of the phonics treatment only recorded a mean change score of -0.89.

In the rate of reading measure, a high statistically significant effect ($p = .005$) was found between groups. The participants that had been exposed to up to 10 weeks of phonics training combined with the music intervention, demonstrated a reduction in their rate of reading of 11.5 words per minute while the groups that had received one type of intervention treatment only, demonstrated a mean increase in their rate of reading. The music intervention group recorded a mean change of 15.48 words per minute and the 5-7 weeks of phonics treatment group recorded a mean change of 4.93 words per minute. This pattern of findings was consistent with similar findings where an increase in the reading comprehension measure and a decrease in the rate of reading measure occurred for participants that received a combination of phonics training and the music intervention for 5-7 weeks in Experiment 'D' and a similar effect was also found for the music intervention group in Experiment 'B'.

A reduction in the rate of reading accompanied gains in reading comprehension in the findings of Experiments 'D' and 'B'. 'Timing' processes between the rate of reading and reading comprehension might be linked although the findings do not offer an explanation for why any such dynamic may exist. The finding has not been consistent or formally established across all the experiments; a decrease in rate of reading mean change scores did not accompany an increase in reading comprehension mean change scores in Experiment 'A' or Experiment 'C'.

It is possible that differing teaching styles may have contributed to variation in the findings between the host schools. A particular emphasis on the development of rate of reading may have occurred during the early stages of reading for the children that participated in Experiment 'B' and Experiment 'D' but not for the children that participated in Experiment 'A' or Experiment 'C'.

No statistically significant effect was found following either the music intervention or the phonics intervention in the reading accuracy measure. Consistent with literacy research into the effect of phonics training on reading behaviour (Porkoni et al., 2004, p.155) the phonics treatment improved phonological discrimination ($p = .042$) but not reading accuracy in Experiment 'D'.

8.2.5 Summary of experimental findings

In the three field experiments, a consistent pattern of significant gains in reading comprehension scores for below average capability readers appears to have emerged. These findings may have been confirmed in Experiment 'D' where improvements in reading comprehension were found for participants that received phonics training in combination with the music intervention but not for phonics training alone. In Experiment 'D' and Experiment 'B', the change in rate of reading score was reduced while a gain in change in reading comprehension score was found, following participation in the music intervention. In the 'two contrasting multi-sensory treatments experiment' (Experiment 'D'), this pattern generated a high statistically significant effect. Interestingly, in this research project improvements in reading comprehension were not usually accompanied by improvements in reading accuracy in spite of improvements in phonological discrimination and phonological awareness.

8.2.6 Findings occurring under trial conditions

The final stage in the project was to trial the music intervention in two schools where the school staff were responsible for its implementation. In School 'E' the music specialist led the exercises. She used an overhead projector to provide the musical notation stimulus and the whole class of 15 pupils joined in. These participants were aged 9-10 years and were in the lowest reading band of the school. In School 'F', 11 participants with low reading attainment, 10 – 11 years of age took part. They were led by two learning support assistants who had no previous experience in reading musical notation. The pupils were extracted from their usual class activities to receive the music intervention in small groups.

The aim of the trial in two schools was to reduce the possibility of 'experimenter effects' during the implementation of the music intervention under investigation in this project. For this reason control groups were not essential and, while reading behaviour was measured both before and after the trial, measures of rhythmic performance and discrimination were not necessary to realise the aims of the trial. To ensure that 'experimenter effects' had not biased the data collection, an auditor investigated the scoring of the trial in two schools.

For the first time in this project, statistically significant findings were found in all three reading measures of the Neale Analysis of Reading Ability (Neale, 1989). Across the two schools, changes in five of the six measures of reading behaviour were found to be statistically significant. Reading ages, available as standardised scores from the normalised data, were included in the findings as an alternative to controls. Over a five-week period, gains in reading age for reading comprehension, reading rate and reading accuracy were found for many of the participants.

A one-way ANOVA, showed statistically significant effects for change in reading comprehension and change in accuracy of reading scores in both schools and for change in rate of reading scores in School 'E'. These findings were supported by reading age calculations, which also described reading profiles for the individual participants.

In the trial the whole class approach was enjoyed by most of the pupils of the School 'E'; their music teacher was full of enthusiasm for the method. The small group approach was less popular, with the learning support assistants battling through the sessions with a group of resistant 10-11 year old children at School 'F'. The learning support assistants did not enjoy the music intervention; they felt it was not valuable for the children. In spite of the negative experiences and attitude of the learning support assistants during the trial, the findings indicated that the trial still had a positive effect. Small differences in the findings between the two schools may be due to the difference of approach in the trial, the age difference of the participants or the different reading programmes preferred by each school.

8.2.7 Summary of empirical findings

From these empirical findings following participation in the music intervention, significant effects in reading behaviour occurred under both experimental and trial conditions. The most consistent area of improvement appeared to occur in the reading comprehension measure for participants that had recorded pre-test scores of below average capability in reading behaviour. An association between weak rhythmic performance, weak rhythmic discrimination and below average reading behaviour was indicated in these experiments. This association possibly supports Atterbury (1985, 1983) though the nature of the association is not implied by this research project. A mild trend, for rate of reading to decrease in association with gains in reading comprehension, was observed for some participants in Experiments 'B' and 'D' and for some participants in the trials in schools.

Findings from Experiment 'D', (sampled from a population of readers with difficulties in maintaining reading fluency, or with difficulties in reading comprehension) appeared to demonstrate that within this sample, differing responses in reading behaviour were found following participation in the treatments.

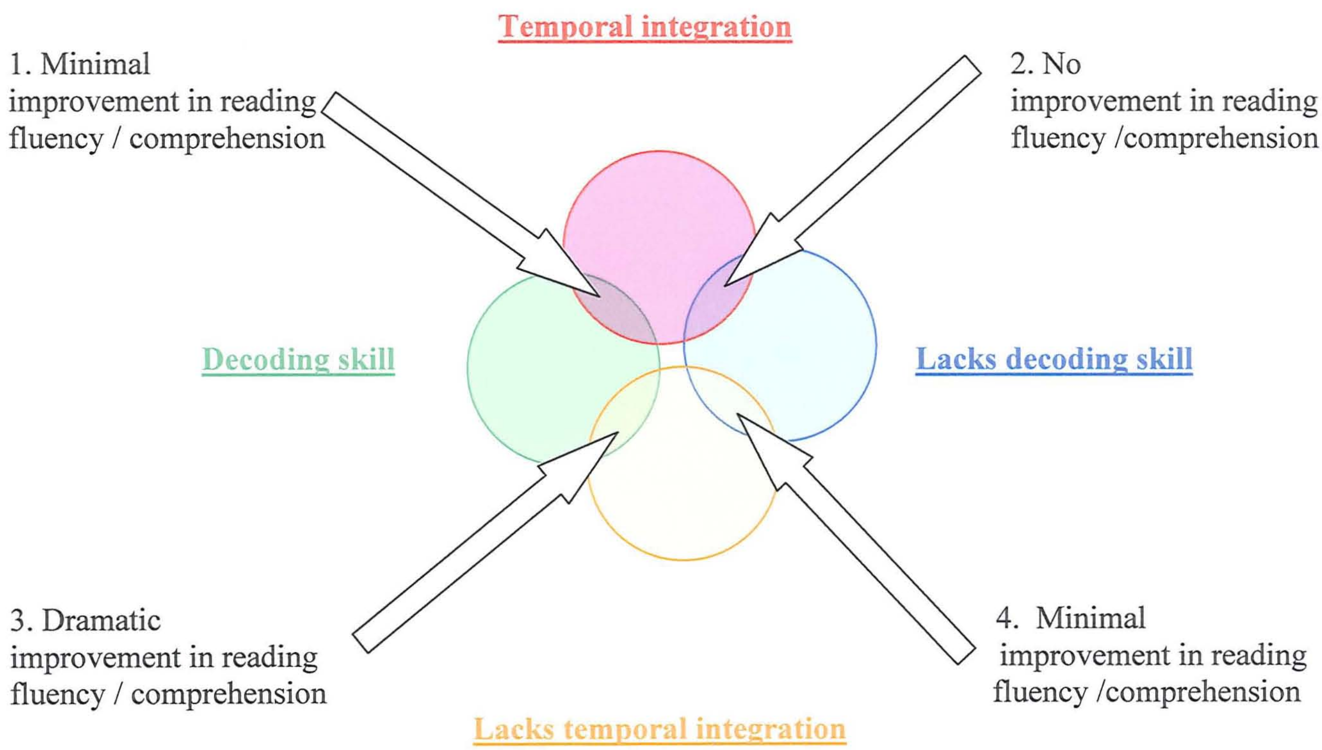
Decoding difficulties such as short-term memory deficit, visual or aural acuity, or perceptual impairments (Reid, 1998) were described in Chapter Five, (section 5.1.15) as interfering with the usual development of phonemic discrimination and word attack skills. It was suggested that these participants were likely to experience some benefit from the music intervention, but any improvement in their 'temporal integration' was likely to be masked by their severe difficulties in decoding.

Four categories of predicted response to the music intervention were suggested by the findings recorded in Experiment 'D'. These categories are set out in Table 8.1 and are illustrated in Figure 8.1

Table 8.1.Categories of differing responses in reading behaviour to the music intervention in relation to decoding difficulties and timing difficulties observed in pre-tests.

Category	Characteristics observed at time of pre-testing		Characteristics at time of post-testing following participation in the music intervention
	Decoding difficulties	**Timing difficulties**	**Changes in reading fluency and reading comprehension**
1	No	No	Minimal refinement of reading fluency and minimum gain in reading comprehension
2	Yes	No	No gain in reading fluency or reading comprehension is expected
3	No	Yes	Significant gains in reading fluency & reading comprehension
4	Yes	Yes	Any gain in temporal integration is inhibited by confounding or masking effects from difficulties with decoding.

Figure 8.1. Categories of differing responses in reading behaviour to the music intervention in relation to decoding difficulties and timing difficulties observed in pre-tests[1].



[1] This diagram first appears in the discussion section of Chapter five, section 5.3.14.

The distinction drawn between difficulties with 'timing' and difficulties with 'decoding' in Experiment 'D' was explored using the reading age profiles yielded by the findings of the trial in two schools. The characteristics in some profiles, in combination with their shared response following the music intervention, suggested that some individual reading age profiles may have been clustered. Each possible cluster consisted of only two or three participants; other participants remained as isolated cases. Most of the participants were defined within clusters described perhaps by Category 3. or Category 4. in Table 8.1. and Figure 8.1. Participants defined by Category 3 often demonstrated reading accuracy age in advance of reading comprehension age at the time of pre-testing. At the time of post-testing the reading comprehension age was often in advance of the reading accuracy age.

Participants defined by the features described in Category 4 experienced weakness in decoding that partially masked any effect of improved 'timing' skills. Although all of the participants were identified by their schools as experiencing difficulties with reading, some participants from School 'E' were possibly described by Category 1., indicating that at the time of pre-testing, they were no longer experiencing acute difficulties with reading.

8.3 Describing the findings in the context of the 'Analysis of Reading Fluency'

Further investigation, into the proposed distinction between the four categories described in the 'Categories of Reading Behaviour' model, involved distinguishing between difficulties with 'timing' and difficulties with 'decoding' in reading behaviour. The 'Analysis of Reading Fluency', focusing entirely on the rhythmic and prosodic elements of reading fluency, did not measure aspects of reading fluency that were attributable to decoding skills such as phoneme-grapheme correspondence and word-attack skills.

8.3.1 Pilot Study : Summary

The Pearson correlations between the salient items of the 'Analysis of Reading Fluency' and the reading comprehension scores recorded significant correlation effects between change in reading comprehension mean end scores with the salient items mean end scores. The item, 'presence of a regular rhythmic foot' correlated with other salient items from the 'Analysis of Reading Fluency' particularly for the sample that received up to 7 weeks of phonological awareness training and participation in the music intervention.

8.3.2 Trial in two schools: Correlations and ANOVA using 'Analysis of Reading Fluency'

Following the pilot study, the 'Analysis of Reading Fluency' was employed to analyse reading fluency derived from data recorded in the trial in two schools. The recordings of reading samples before and after the music intervention period in School 'E' and School 'F' were processed using the 'Analysis of Reading Fluency'. A statistically significant effect ($p < .01$) for a moderate positive correlation was found in both School 'E' and School 'F', between mean change scores in reading comprehension (Neale, 1989) and 'presence of a regular rhythmic foot' from the 'Analysis of Reading Fluency'.

A within groups one-way ANOVA was conducted on pre-test and post-test findings of the salient items: 'presence of subject and predicate', 'presence of pitch contour', 'presence of a regular rhythmic foot', from the 'Analysis of Reading Fluency'.

A highly statistically significant effect was found in School 'E' in the dependent variable 'presence of a regular rhythmic foot' ($p < .001$) with a mean pre-test score of 46.76 and a mean post-test score of 87.89. In School 'F' following analysis of the same item, a statistically significant effect ($p = .02$) was found. The mean pre-test score was 60.35 and the mean post-test score was 88.63.

In the dependent variable 'presence of subject and predicate' a highly statistically significant effect was found in School 'E' ($p < .001$) with a mean pre-test score of 38.15 and 65.83 as a mean post-test score. In School 'F' analysis of the same item produced a statistically significant effect ($p = .036$) with a mean pre-test score of 6.93 and a mean post-test score of 28.79.

A highly statistically significant effect was found for the salient item, 'presence of pitch contour over the tone group' in Schools 'E' and 'F' ($p = .005$). In School 'E' the mean pre-test score was 18.33 and the mean post-test score was 44.17. Higher scores were found for School 'F' where the mean pre-test score was 34.68 and the post-test mean score was 68.18.

By recording statistically significant effects in the 'presence of a rhythmic foot' for reading behaviour during the trials in School 'E' ($p < .001$) and School 'F' ($p < .05$), it was possible to propose that gains in temporal organisation of reading behaviour may have been made following participation in the music intervention. Statistically significant effects, recorded in change scores in: 'presence of subject and predicate' for School 'E' ($p < .001$) for School 'F' ($p < .05$) and 'pitch contour over the tone group' in both schools ($p < .01$), suggested that gains at the phrasing level in reading fluency occurred.

8.3.6 Summary of 'Analysis of Reading Fluency' findings

The central focus of this research project was with the temporal organisation component of the music intervention and whether any effect of the temporal organisation component of the music intervention impacted upon reading behaviour. Findings generated by the 'Analysis of Reading Fluency' supported the empirical findings generated by the Neale Analysis of Reading Ability (Neale, 1989) during Experiment 'D' and the trial in two schools. The participants most likely to benefit from the music intervention have been observed in the 'Analysis of Reading Fluency' to demonstrate improved processes associated with temporal organisation in reading behaviour and improved reading comprehension scores in the Neale Analysis of Reading Ability (Neale 1989).

The participants that generated reading samples representing Category 3 of the Categories of Reading Behaviour Model, (see CD, Tracks 1, 2 and 3) demonstrated improvements in the temporal organisation component of reading fluency in the absence of acute decoding difficulties.

The participants that generated reading samples representing Category 4 of the Categories of Reading Behaviour Model, (see CD, Track 4) demonstrated improvements in the temporal organisation component of reading fluency masked either wholly or partially by acute difficulties with decoding.

8.4.1 The overall findings and the theoretical framework

The main focus of this study has been concerned with temporal organisation. The music intervention under investigation in this study, described as a multi-sensory entrainment activity, has demanded an orchestration of participants' attentional resources across different modalities. This is suggested to be highly effective in limiting the degrees of freedom of the brain.

While the music intervention has been described as an entrainment method and has been contextualised within dynamic attending theory, the consideration of a possible transfer effect has required a deconstruction of the music intervention into physical components of impact, time and space. In keeping with dynamic attending theory which considers real time ratios, 'time' has been described as a regulating and integrating factor in relation to a hypothetical model, the 'Hierarchy of Knowledge Acquisition'[2] (see Figure 8.2). In the 'Hierarchy of Knowledge Acquisition', 'temporal integration' is subject to 'temporal regulation' and knowledge acquisition is subject to 'temporal integration'.

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[2] The 'Hierarchy of Knowledge' first appears in Swanwick, K, (1994,p.29) as a term and as a pyramidal diagram describing the process of knowledge acquisition set out by Croce (1900).

Figure 8.2. 'Temporal regulation' in relation to the 'Hierarchy of Knowledge Acquisition' (Swanwick, 1994, p.29)

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[redacted]

This hypothetical model suggests a framework for a discussion of the issues surrounding the difficulties experienced by school children in reading, and the effect of the music intervention. In Figure 8.2, 'rhythmic patterns', which may be classified as 'Sensory Matter' represent the physical component of the music intervention in the 'Hierarchy of Knowledge Acquisition' model. The stamping, clapping and chanting activity, intrinsic to the music intervention, resonates with the legacy of stamped impulses in the cultural practices of pre-history. Researchers (Brown, Merker & Wallin, 2001, p.12), Chapter Two (section 2.8) in the field of biomusicology have suggested that the ability of humans to entrain themselves to an external timekeeper is a species-specific trait.

A weakness in rhythmic performance has been associated with reading difficulties (Atterbury, 1983,1985; Overy, 2000). Support for this association is suggested by the findings from this research project. Findings from Experiment 'C' indicated that a weakness in rhythmic performance was associated with reading difficulties. Significant interaction effects followed participation in the music intervention in change scores in reading accuracy and reading comprehension for participants with a weak sense of metrical pulse and below mean capability scores in reading accuracy. The significant interaction effects suggested that 'temporal integration' may occur due to improved 'temporal regulation'.

Rhythmic gestalts, classified as 'Intuitive Knowledge' (Figure 8.2) in the model suggest a 'timing' component, identified by Patel & Peretz, (1997, p.208) in language processing. Rhythmic gestalts are implied in the salient items of the 'Analysis of Reading Fluency'. The 'presence of a regular rhythmic foot' ('Analysis of Reading Fluency') is a particularly interesting example as this salient item became more prominent in the reading behaviour of below average capability readers following participation in the music intervention. The regular rhythmic foot has been identified as an innate temporal pattern by Meyer (1956), Mursell (1937) and Vos (1973) though in this research project, the findings suggest that, prior to participation in the music intervention, this pattern was not automatically present in the reading behaviour of below average ability readers.

It is hypothesised that the combined 'time-space-impact' components in the stamping, clapping and chanting activity of the music intervention, enabled the innate rhythmic patterns (found to be temporally integral to the phrase contours of speech), to develop in reading behaviour. As an entrainment activity, the music intervention is proposed to have achieved an effect on reading behaviour, by demanding an orchestration of participants' attentional resources across different modalities simultaneously. In post-test reading samples following participation in the music intervention, data from Experiment 'D', School 'E' and School 'F', presented significant effects for Change in 'presence of a regular rhythmic foot' which suggested that the hypothetical process of 'temporal integration' (see Figure 8.2) may have occurred following participation in the music intervention.

'Logical Structures', identified in Figure 8.2. as 'Conceptual Knowledge', have been associated with 'timing' processes in the writings of Jones (1976) and Neisser (1967). The influence of 'temporal regulation' upon 'Logical Structures' or 'Conceptual Knowledge' is discussed here in relation to prosodic reading processes. Prosodic reading processes have been related to reading comprehension by Schreiber (1980, p.179) and Allington, (1983, p.559). Prosodic features in reading behavior have been generally described as 'pitch contour' or 'intonation' (I suggest these may represent 'space' dimensions); and as 'lengthening of phrase boundaries' or as 'rhythmic metre' (I suggest these may represent 'time' dimensions).

In the findings of a study by Wingfield & Nolan, prosodic features were found to influence the generation of segmentation hypotheses (Wingfield & Nolan, 1980, p.100). According to Neisser (1967) the most powerful organisational tool of the segmentation process is rhythm. This finding has been confirmed by Overy, (2000) who explained that a correlation between reading ability and rhythmic ability in 'song tapping' exercises was indicative of temporal organisation in segmentation processes. Studies investigating the formation of segmentation hypotheses, have been demonstrated to have been influenced by the syntactic and semantic interface (Wingfield & Nolan, 1980). This process has been confirmed by Dowhower, (1987) who described reading fluency in terms of the formation of segmentation hypotheses:

> 'Fluent readers organise words into meaningful phrases (Clay & Imbach, 1971; Gibson & Levin, 1975; Snow & Coots, 1951, cited in Dowhower, 1987, p.392), whereas unskilled readers have difficulty in grouping words that go together' (Coots & Snow, 1951; Cromer, 1970, cited in Dowhower, 1987, p.392).

The simple binary system of Jones' (1976) dynamic attending theory, in the context of the relationship between intonation of phrase structures and syntax proposed by Jones and Yee (1993, p.104), and in the context of Halliday's (1976) theory, may be understood as a process that facilitates the linking of 'new' information with 'given' information, fundamental to forming 'Logical Structures' and to generating 'Conceptual Knowledge'. Interestingly, Chafe (1970) discussed in Chapter seven, (section 7.1.4) also offers a binary system that may be applied usefully to syntax:

> 'the total human conceptual universe is dichotomised initially into two areas. One the area of the verb, embraces states, conditions, qualities and events; the other, the area of the noun, embraces 'things' (Chafe, 1970, p.93).

Common to both Chafe (1970) and Jones (1976), a binary system appears to naturally correspond with three separate conceptual process:

i. The concept of 'Subject and Predicate' ('Analysis of Reading Fluency') relevant to the generation of segmentation hypotheses,
ii. The concept of 'expectancies' (Jones and Boltz, 1989),
iii. The consideration of information in the context of the immediate reference frame and also in the context of prior knowledge (Anderson, 1992).

These three, possibly nested, features of comprehension all share a binary feature in their logical structure. It was suggested in Chapter Two (section 2.9) that binary processes found in 'Logical Structures', might relate to the legacy of cultural practices that were binary in style such as 'harmonious dances' (Sachs, 1937).

The music intervention may have benefited a temporally organised aspect of logical structure that may contribute to reading behaviour. This explanation is supported by theoretical work by Halliday (1985) detailed in Chapter seven, (section 7.1.3, 7.1.4) describing a hierarchy of rhythmic structures intrinsic to the syntax and semantic constituents of spoken and perceived language. These issues are addressed further in section 8.5.2. Evidence for a temporally organisational effect upon the logical structures involved in reading behaviour following participation in the music intervention, are suggested by findings from the 'Analysis of Reading Fluency' for Experiment 'D' and the 'trial in two schools'. These were, statistically significant effects for 'presence of subject and predicate' ('Analysis of Reading Fluency') from data in School 'E' and School 'F' and, significant correlation effects between reading comprehension change scores and 'presence of a regular rhythmic foot' from data in Experiment 'D' and from the trial in School 'E' and School 'F'.

The significant effects in change in reading comprehension scores in Experiments, 'A', 'B', 'C', 'D' and under trial conditions in School 'E' and School 'F', may be viewed in relation to gains in temporal organisation found in reading fluency scores. Together, these suggest that temporal organisation (see Figure 8.2) may have occurred following participation in the music intervention.

8.5.1 Contribution to knowledge

The aim of this research was to investigate the effect of a music intervention on reading behaviour. The investigation was conducted as an experimental study with a central focus on 'timing'. School children with below average baseline scores in reading made gains in reading comprehension but not reading accuracy following participation in the music intervention. These findings were repeated under the conditions of trials in two schools where school staff led the music intervention. Findings of correlations between the Neale Analysis of Reading Ability (Neale, 1989) and the 'Analysis of Reading Fluency' suggest that improvements in reading comprehension may be associated with improved reading fluency.

8.5.2 The relationship of the contribution to knowledge to existing literature

In Chapter two, observations of children's reading by Oakhill (1993) recorded a style of reading behaviour that was described as word by word, with no inferences and no syntax. This stilted reading style was, according the study not caused by poor decoding (Oakhill, 1993). Similar observations (Cromer, 1970) have identified a group of children who were able to decode well but comprehended poorly because they treated words as single units, unmodified by syntax and semantic context. This discrepancy in reading behaviour was first identified by Cromer (1970) as 'Reading Comprehension Deficit'.

I have attempted to express a distinction between 'timing' and decoding skills by developing 'The Categories of Reading Behaviour Model' where 'Reading Comprehension Deficit', is suggested by Category 3. in which readers demonstrated difficulties with 'timing' but not decoding. Findings from this research project, suggested that difficulties with 'timing' may account for a 'Reading Comprehension Deficit'.

In keeping with Jones' (1976) theory of dynamic attending and a cognitive perspective, a model outlining the relationship between prosody and language rules, described by Halliday, (1985) weaves rhythm and meaning together into a hierarchical arrangement that provides cues and signals for the accurate uptake of information. The 'foot' organises a number of syllables into 'rhythmic patterns' but not into information units (Halliday, 1985, p.295). At this level in the hierarchy there is no semantic quality associated with this rhythmic patterning. Semantic qualities, nevertheless, are present in 'tone groups' (which identify a subject and predicate). According to Halliday, (1985, p.294) 'tone groups' are structured around the 'rhythmic patterning' and around the strong, then weak, phonological structuring of the 'foot'.

This hierarchy (Halliday, 1985) resonates with the work of Neisser (1967) who identified 'phrase markers' as internal rhythmic devices that group successive words into segments and distinguish appropriate stress and contour according to a the processes of on-going conceptual hypothesis generation. Linguistic analyses detailed in Chapter seven, section 7.1.4 (fig.7.1) show that where syntactic organisation displays ambiguous meaning, an alternative form of low frequency organisation of the text is capable of providing sufficient prosodic cues for the semantic aspects of the text to be processed, unhindered by syntactic ambiguity.

This low frequency level of organisation, a rhythmic device marking out phrase boundaries, was identified by Neisser (1967, p.262), and later, Klein and Jones suggested

> 'listeners 'use' the pattern of time intervals to influence the timing of attentional pulses that determine expectations' (Klein and Jones, 1996, p.44).

Both of these factors may, I suggest, support Goodman's assertion that,

> 'efficient reading does not result from precise perception and selection of all the elements, but from skill in selecting the fewest, most productive cues necessary' (Goodman,1967, p.127).

I suggest that at this low-frequency level, a subliminal, dynamic relationship between phrase boundary rhythm and the processing of semantic events may exist. The findings in this research project support arguments favouring temporal organisation as a factor in the synthesis of prosodic cues that support syntactic and semantic hypothesis generation.

Preliminary pilot findings using the 'Analysis of Reading Fluency' in Experiment 'D', suggested significant correlation effects between the salient items 'appropriate use of stress and pause' and 'presence of a regular rhythmic foot' and mean change reading comprehension scores (Neale, 1989). The strongest correlation was found between reading comprehension mean change scores and 'presence of a regular rhythmic foot' for the group that received up to 7 weeks of phonological awareness training combined with the music intervention. For the group that received up to 10 weeks of phonological awareness training combined with the music intervention (participants with weaker decoding skills) the most prominent correlation was found between reading comprehension mean change scores and 'appropriate use of stress and pause'.

Jones' theory of dynamic attending described the transformational effects between different hierarchical levels of dynamic attending as,

> 'lower-order motion properties periodically evolve various higher-order attentional periodicities, thereby facilitating a concurrent 'locking-in' of nested attentional rhythms,' (Jones and Yee, 1983, p. 82).

Correspondingly, 'Presence of a regular rhythmic foot' has been described in Halliday's hierarchical theory as the organisational element underpinning the rhythmic structure of 'tone groups' that act as 'information units' (Halliday,1985, p.293). The 'appropriate use of stress and pause' may possibly correspond to the low frequency level of organisation identified by Neisser, (1967, p.256) as 'phrase markers' (see fig. 7.2) which I suggest may possibly precede the 'presence of a regular rhythmic foot', in the development of reading fluency.

In studies described in Chapter Five (section 5.2.2) where a strategy of 'repeated reading' of a single text has been applied as an intervention, improvements have been found in reading comprehension (Schreiber, 1980). A modified version of the 'repeated reading' strategy, described as 'supported repeated reading', involves the addition of a reading model, administered through a tape recorder or by an adult reader, guiding the prosodic aspects of the 'repeated reading' process. Improvements in reading comprehension have been found in 'tape assisted supported repeated reading' (Chomsky, 1976). Schreiber (1980), described the process of training readers to recognise syntactic structures, segments and phrases in Chomsky's (1976) work. Little empirical work exists in subsequent support of Chomsky's (1976) study and research into the effectiveness of supported 'repeated reading' has remained inconclusive. In particular, critics of the 'repeated reading' programme expressed concern that reading comprehension skills achieved on one set text may not transfer to unfamiliar texts.

Findings from this project suggested that the effect of the music intervention may be similar to the effect of the 'supported repeated reading' strategy in training readers to recognise syntactic structures, segments and phrases. This implies that the music intervention provided a possible 'model' for the temporal organization of reading. This type of application of the music intervention may be attributed to the activation of the temporal patterns which may have an 'entraining' or integrating effect upon subliminal 'timing' processes and binary logical structures. The findings in this study support correlations between various aspects of oral reading fluency and capability in comprehension (Allington,1983, p.559).

The relationship between sensory movement impressions and the brain, considered by several theorists, has involved placing bodily movement into a proposed spatial-temporal framework. This approach is common to each of the theories of Gardner, (1973) Jaques-Dalcroze (1921 / 1973) and Laban (1973). Dimensions of space and time in prosodic speech are described by Halliday (1985) at the level of the rhythmic foot, and by Neisser (1967) at the level of the phrase contour. Findings from this research project have provided support for the theories of Halliday (1985) and Neisser (1967).

The music intervention involved strong, muscular movement of the body and controlled, coordinated motor responses to musical rhythm in keeping with the teachings of Jaques-Dalcroze (1921/ 1973). In addition, the music intervention involved impact in bodily movement enabling time-rhythm to become associated with weight-rhythm in accordance with the teachings of Laban (1973). The conveyance of sensory information by a spatial-temporal framework, described by Gardner (1973) as the function of a 'preverbal modal-vectoral chord' where modes are space oriented and vectors are time oriented resonated with the view of Jaques-Dalcroze, who described the movement of the body as requiring a 'quantum of space and a quantum of time' (1921/1973, p.37). A hierarchical progression, from sensory impressions to the formation of mental 'images', put forward by Jaques-Dalcroze (1921/ 1973, p.68) became theoretically distilled when he speculated that stronger muscular movements would produce stronger mental images and an even more vivid imagination (1921/1973, p.68). This research project has supported the theoretical position of Jaques-Dalcroze by contributing empirical evidence, demonstrating that participation in a music intervention may improve hypothesized time-space dimensions in prosodic reading behaviour, leading to gains in reading comprehension.

8.6 Limitations of the study

8.6.1 The sample

This research project has been conducted in schools where pressures of the curriculum timetable have been restrictive. For this project, individually administered testing was required. Although testing procedures were consistent within each experiment, the testing process was limited by constraints on time. Some schools were unwilling to allow pupils to participate in morning testing sessions; testing was sometimes limited to afternoons. This restriction of access to the participants limited the amount of data collection that was possible through individually administered tests and therefore the size of the samples was restricted. Experiments 'A', 'B' and 'C' were exploratory and the aim of the project at this initial stage was to establish whether or not the music intervention would have any effect on the reading behaviour of school children. The small size of the sample implied that sampling error was likely to be high in this study even at the exploratory stage. Limits upon sample size occurred generally but particularly in Experiment 'D' where the researcher required the sample to represent a population of readers with weakness in concentration or reading comprehension. Therefore it was not intended that the sample used for this project would be representative of the school population in general. However, the limitation of sample size strongly reduced the external validity of the findings.

Restrictions upon the amount of time spent in contact with the sample during the intervention treatment sessions were particularly limiting in Experiment 'D'. Lateness and disruption from individual participants affected the progress of the intervention treatment sessions. The extraneous events that frequently occurred between the pre-tests and the post-tests threatened the internal validity of the research. For this reason the design of Experiment 'D' was adapted to allow for more contact time between the participants and the intervention treatments, thereby supporting the internal validity of Experiment 'D'. The disruptive behaviour of some participants in Experiment 'D' had not assisted the smooth running of the study but had provided ecological validity as such occurrences are normal in school life.

Some experimental mortality occurred in most schools but particularly in Experiment 'B' where the post-testing dates coincided with the effects of a prevalent sickness bug. The loss of participants reduced the sample size however, internal validity of Experiment 'B' was not unduly affected as the remaining sample was not biased as a result.

Under trial conditions, where learning support assistants were conducting the music intervention, several participants were uncooperative. The resistance to the music intervention from individuals in School 'F' threatened internal validity of the trial. Nevertheless the findings showed an impact, even under these adverse conditions. The implication of this finding strengthened the ecological validity of the trial as resistance to the music intervention from individual participants was not untypical of everyday behaviour in an educational setting.

8.6.2 Methodological / Contextual Limitations

A criticism of experimental research that,

> 'effects may be more subtle or difficult to conceptualise than researchers allow for' (Scott & Usher, 2000, p.65),

described a limitation of this study since a direct behavioural measure of 'temporal organisation' does not exist. This threatens the construct validity of the investigation. The consistent findings of this study however, suggested that an underlying change occurred that may be associated with gains in temporal organisation and by implication in the latent construct, 'temporal integration'. The absence of an explicit measure of fluency in reading has arguably resulted in the under-representation of timing skills in reading behaviour in the literature. Indeed, Scott & Usher (2000, p.64) refer to the shortcomings of standardised reading ability tests as 'blunt tools' for this type of study. To remedy this limitation, the 'Analysis of Reading Fluency' was developed during the study. However, this measure was limited as it had not been used before; there was no criterion-related validity and it was not a standardised test. However, correlational and ANOVA suggested some initial validity and reliability for this measure.

In Experiment 'A', the first experiment in the exploratory stage of the project, a large number of dependent variables were included in the statistical analysis. The large number of dependent variables increased the likelihood of committing Type I error (a false positive finding) which would mean that the null hypothesis would be rejected when it was in fact true. For this reason the number of dependent variables was reduced for subsequent analyses. In addition, in Experiment 'A', a ceiling effect was observed to occur in the test of rhythmic discrimination from the Seashore Measures of Musical Ability (Seashore, Lewis, Saeveit, 1939). The age of the sample was reduced from 9 -10 year olds to 8-9 year olds for subsequent field experiments, thereby resolving the difficulty.

A third limitation, also raised by Scott & Usher (ibid) was that in experimental research, insufficient time may be available for the effect to occur. This difficulty did arise in Experiment 'D' where two methodological difficulties occurred. Threats to internal reliability were caused by an unforeseen slowness of response from the participants to the two intervention treatments and this issue coincided with a fixed time frame from the school for implementing the experiment. As well as some disruption caused by 'individual factors', 'situational factors' that occurred may be attributed to the coincidence of the music intervention sessions with the games lesson, school play rehearsals and academic pressures on the timetable during the term before Key Stage Two S.A.T.S. testing. At the time of mid-testing, the predicted response to the interventions had not occurred. On the basis of consistent findings from Experiment 'A', 'B' and 'C', and on the basis of teaching experience, it was speculated that the participants would respond positively to the interventions if extended treatment periods were offered. This alteration was justified by maintaining the ethical position of the research at the expense of the experimental design. The decision to provide the participants with extended intervention treatment periods within the tightly prescribed timeframe, involved removing the planned experimental contrasts from Experiment 'D' and deliberately introducing 'interaction effects' took account of the changes and the differing number of weeks of phonological awareness training that the participants had received. Although, this form of 'interaction' between the treatments was unplanned in the second half of Experiment 'D', the ecological validity of the investigation may have been strengthened by the changes to the experimental design.

The progress of this project during experiments 'A', 'B', 'C' and 'D' was consolidated by a trial in two schools. In the trial, the researcher was not involved in implementing the music intervention. The trial enabled the removal of 'experimenter effects' that may have influenced the experimental phase of the project. The significant effects that were sustained in the trial phase of the project suggested that 'experimenter effects' had not influenced the earlier phases of the project. The audited findings of the trial suggested that 'demand characteristics' or 'experimenter expectancy effects' were not present.

8.7.1 Generalisability of the findings

Due to the limitation of time and expense, a non-probability sample was deliberately used for this piece of small-scale research. Only a few schools were used and the samples from each school were small. Arguably, it is inappropriate to attempt to generalise the findings of this research project beyond the experimental samples to the wider population, although some generalisability is suggested by the use of controls in this investigation. The findings of this study have been broadly consistent, suggesting internal reliability. Replication, using a probability sample, is needed for the findings of this study to be generalisable to a wider population.

8.7.2 Implications for schools

The central focus of this research project was temporal organisation. 'Timing' skills in reading have not been widely reported in the literacy literature and this study may contribute to a new awareness of 'timing' skills in reading development in schools. The findings suggest that 'timing' skills in reading were weak among school children with poor reading comprehension skills. Children with a weakness in reading comprehension also demonstrated a weak sense of metrical pulse. Findings from the experiments and the trial implied that schools may assist below average capability reading behaviour pupils by adopting the music intervention as a means of improving 'timing' skills in reading.

The 'Analysis of Reading Fluency' was developed for this research project as a tool for measuring 'timing' skills in reading behaviour. The 'Analysis of Reading Fluency' is relatively labour intensive and therefore costly to administer in its current form. However, the 'Analysis of Reading Fluency' may be developed as a software package using speech synthesis technologies and eventually become available for teacher assessment of 'timing' skills in reading behaviour.

The Categories of Reading Behaviour Model may be used by schools to differentiate between 'timing' difficulties and decoding difficulties in reading behaviour and perhaps to appropriately assign school children to the music intervention.

During the enquiry, the gains in temporal organisation generally appeared to be recorded as gains in reading comprehension but not reading accuracy. However, some participants from Category 3 of the Categories of Reading Behaviour Model experienced gains in reading accuracy as well as gains in reading comprehension. This finding was unusual and may be specific to this sample only, and / or a feature that may characterise the reading behaviour of those described as Category 3 of the Categories of Reading Behaviour Model. Replication of the study, using a larger probability sample would enable further exploration of this issue and any relationship between reading accuracy and reading comprehension in the context of 'timing' skills in reading behaviour.

During the music intervention, the participants learned to read simple musical notation with success and confidence. This implied that the music intervention provided a suitable group method for teaching musical notation to below average capability readers. The implication of this learning outcome strongly suggests that musical notation reading skills can be acquired by below average capability school children. The music intervention provided a rhythm-based approach to reading musical notation that can encourage group cohesiveness and the development of musical ensemble skills, that were described in Chapter One, (section 1.1.1).

In Chapter Six, (section 6.3) the findings of the trial in two schools indicated that the music intervention may be directed with success by school teaching staff, whether music specialists or learning support assistants with no previous music teaching experience or previous knowledge of musical notation. The music intervention can be applied in a whole class setting or in small groups. The findings of the trial in two schools suggested that a whole class approach, led by a music specialist, was more effective and enjoyable for the pupils.

8.7.3 Practical Implications

Findings of this study imply that further investigation and consultation with practitioners might now be appropriate. More extensive research and subsequent practitioner consultation would indicate whether teachers of reading and teachers of music might adopt the music intervention as a pedagogic tool. Subject to further investigation, consultation with policy makers and headteachers might result in the consideration of the music intervention within future curricula organisation. It is suggested that educators might consider adopting this music intervention for ameliorating 'timing' difficulties among below average capability readers. The music intervention may be integrated into the school timetable as part of the Key Stage Two Music Curriculum or as a group multi-sensory activity to remediate learning difficulties. Minimum materials consisting of floor space, access to drinking water, an overhead projector or music stands, a CD player and speakers, simple musical notation, were required for the music intervention; each session of the music intervention lasted 10 minutes. Difficulties in 'timing' in reading behaviour may be assessed by administering the 'Analysis of Reading Fluency' and the 'Categories of Reading Behaviour' model.

8.7.4 Limitation of Applications

In the 'Categories of Reading Behaviour' model (Table 8.1., Figure 8.1.) readers, identified within Category 4 had acute difficulties in decoding and 'temporal integration'. Findings from this research project implied that limited improvement was found for the reading behaviour of these pupils following participation in the music intervention. Although readers in Category 4 benefited from improved 'timing' in their reading behaviour, any improvement was masked by acute difficulties with decoding. It is likely that school children experiencing difficulties with decoding would also benefit from additional multi-sensory interventions such as phonics training and consideration of additional sensory interventions such as using tinted spectacles and / or auditory perception training. The remediation of decoding difficulties was beyond the scope of this investigation, though in Experiment 'D', children responded most positively to phonics training combined with the music intervention. It is acknowledged that for some school children, acute decoding difficulties may have partly obscured the benefit of the music intervention on gains in 'timing' skills in reading behaviour.

8.7.5 Implications for further research

Although this investigation has been conducted on a small scale using small samples from only a few schools, effects occurred consistently during the enquiry which suggested that participation in the music intervention benefits 'timing' skills in reading behaviour. The outcome of this investigation has implications for further research using larger samples. A replication of this study using a larger sample would generate findings that could be generalisable to a wider population. The refinement of sampling that occurred during the progress of this project suggested that further research should target a population of below average capability readers, particularly with a weakness in 'timing' skills or a weakness in reading comprehension. Moreover, while the 'repeated reading' approach (Chomsky, 1976; Allington, 1983) has been criticised for a non-transferable outcome from familiar to unfamiliar texts, the findings of this study indicated that gains in reading fluency and reading comprehension were transferable to unfamiliar and unpractised texts. However more work is needed to establish the duration of the effect following participation in the music intervention. Would further exposure to rhythm-based music instruction be necessary for the effect to be sustained? In addition it is recommended that variability in educational background is included as a useful modification of the design by assessing 'style of reading pedagogy received', and 'attitude to reading' of future samples.

According to the theoretical underpinnings of this study, the proposed effect of the music intervention was to increase 'temporal regulation' and 'temporal integration'. In this research project I have argued that the process of knowledge acquisition is partly dependent on 'temporal regulation' and 'temporal integration'. An implication of the findings of this research project suggests that further research looking into the effects of the music intervention on numeracy behaviour. Numeracy, similar to reading behaviour, requires conceptual knowledge acquisition and similarities between music and mathematics suggest commonalities between the two disciplines do exist.

In the trial phase of this research project, a participant diagnosed with A.S.D., Autistic Spectrum Disorder, pupil 8 from School 'F', was included in the music intervention. In the post-tests, this participant answered 'Pass' to all the reading comprehension questions; consequently a decrease in reading comprehension score was recorded. Nevertheless, evidence of global processing and improved syntax, independently observed in his reading by an A.S.D. specialist (see CD, Track 5) suggested that the music intervention may be suitable for further research in a global processing study on the A.S.D. population.

During the music intervention treatment sessions, many children expressed some surprise and a sense of relief as they achieved the high level of coordination and physical control required by the music intervention. The views of some of the participants in Schools 'E' and 'F', described in Chapter 6 Table 6.3 and Table 6.5 implied that a profound change, beneficial to their sense of wellbeing occurred. These observations suggested that 'entrainment' effects, providing support for the latent concepts of 'temporal regulation' and 'temporal integration', may provide a focus for further research into possible therapeutic benefits of the music intervention.

The Categories of Reading Behaviour Model was effective in distinguishing between decoding and temporal error types in the context of reading accuracy scores (Neale, 1989). This refinement in error measurement may have implications for further research in the field of developmental dyslexia.

A methodological tool, the 'Analysis of Reading Fluency', which measures 'timing' skills in reading behaviour was developed for this investigation. This may be useful for any research project that investigates 'timing' processes or fluency in reading behaviour. The development of a software package of this measure would minimise the labour intensive aspect of its use and could lead onto a large scale project in which reliability co-efficients, criterion-related validity and normative data can be developed.

A mirroring effect between gains in reading comprehension and a decline in the rate of reading occurred in the trial in two schools, in Group 3A from Experiment 'D' and in the sample from Experiment 'B'. Reading experts (Dowhower, 1987) have found that ability in reading comprehension is correlated with reading 'with expression'. Reading 'with expression' is referred to in the Neale teacher's manual in association with lower rates of reading (Neale, 1989, p.59). A slower rate of presentation of the test has been argued to allow for more active organisation of the text (Neisser, 1967, p.222). This argument, together with some intriguing empirical data from this research project has implications for further research in cognitive processes concerning 'timing'. This issue may need to be addressed quite urgently as in this investigation, some children were habitually found to be reading at a rate that exceeded the rate of their ability to comprehend the text. It is possible that some teachers promote a fast rate of reading instead of slower more expressive reading which may be related to under performance in reading comprehension scores.

Findings from the trial stage of this research project indicated improvements in reading fluency following participation in the music intervention. A challenge to music educators: 'Fluency, first and last', declared by Swanwick (1999, p.55) might inspire an investigation into the *musical fluency* of below average reading capability pupils. The investigation into the music intervention was initiated following the increased musical fluency of a group of below average capability school children. Further research into the musical outcomes following participation in the music intervention would perhaps provide an optimistic response to Swanwick's challenge.

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Appendices

Appendices

Contents

Contents

List of tables and figures

Appendix I

Neale Analysis of Reading Ability Form 2 (1989, Revised Edition) descriptive statistics in raw score units

DIAGRAM SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

Appendix II

Seashore Measures of Musical Talents (1939) Descriptive statistics in raw score units for the Rhythm Test

Score	Grades 4-5 % ile	Grades 6-8 % ile	Grades 9-16 % ile
30	99	99	99
29	99	97	90
28	96	91	73
27	91	83	55
26	83	72	39
25	74	60	28
24	64	48	19
23	53	38	12
22	42	28	8
21	33	21	5
20	24	16	3
19	18	11	2
18	14	8	1
17	11	5	1
16	8	4	1
15	6	2	1
14	4	2	1
13	3	1	1
12	2	1	1
0-11	1	1	1
N	3476	2499	4024
Mean	22.6	24.0	26.5
Std. Deviation	4.0	3.8	2.8
Coefficients of reliability	.67	.69	.64

Appendix III

The reliability of the Movement ABC (Henderson & Sugden, 1992) data is set out in Appendix III. cites its predecessor: 'The Test of Motor Impairment' (Henderson Revised, 1984) as the item content does not differ much from the Movement ABC (1992). The results of the analysis of the individual items varied from 75% agreement to 98% agreement. The minimum value of the test-retest reliability at any age was 0.75. The findings of two investigation into the validity of the 'The Test of Motor Impairment' (Henderson, Revised, 1984) firstly by teachers: Henderson and Hall, (1982, cited in Henderson & Sugden, 1992) were statistically very highly significant ($p < 0.001$) and secondly by teachers Lam and Henderson, (1987) who measured the correlation between the items as 0.58 with a high statistical significance of $p < 0.01$ in one investigation and in a second investigation measured the correlation between the items as 0.88 and found a very high level of statistical significance as $p < 0.001$. A study into the validity of 'The Test of Motor Impairment' (Henderson, Revised, 1984) by paediatricians: Losse et al., (1991, cited in Henderson & Sugden, 1992) found the correlation between the items to be 'very close'; paediatricians Marlow et al. (1989, cited in Henderson & Sugden, 1992) found the correlation between the items to be 0.49 and a very high level of statistical significance of $p < 0.0001$.

Appendix IV

Matching Procedure

Introduction

According to Robson, (1993:93) matching participants is highly advantageous in the research setting of the field experiment. In field experiments the potential threat posed by external variables is high but conversely, the realistic research environment ensures that external validity is also high. If controls are imposed on a field experiment to counteract the threat of external variables, any threat to the external validity of the investigation is reduced. For the researcher working in a field experiment, the challenge lies in safeguarding external validity while controlling for potential confounding variables. The experimental technique of matching-participants as pairs who share a very similar character or score in a factor that is sensitive to the dependent variable, provides a way of controlling the research environment without damaging the realistic setting or the generalisability of the field experiment.

Rationale for matching participants

The four experiments in this study investigated reading behaviour of schoolchildren. The hypothesis underpinning the investigation proposed that 'timing' was important in reading behaviour. The dependent variable in these experiments was 'temporal organisation' and the independent variable was participation in the music intervention.

The measure of 'temporal organisation' in these investigations was indirectly implied by measurement of reading behaviour through reading accuracy, reading rate and reading comprehension (Neale, 1989). It was important to ensure that ability in reading behaviour was matched between the group participating in the music intervention and the control group in Experiments 'A', 'B' and 'C' and that ability in reading behaviour was matched between the group participating in the music intervention and the phonological awareness training group in Time One of Experiment 'D'.

Differences between the two groups in reading ability may have otherwise interfered with any experimental effect that might have occurred. By matching the participants as matched pairs, a potentially confounding variable of differences in reading ability of participants was avoided.

In the pilot study, reading comprehension scores were more changed than reading rate or reading accuracy. Although the experiments were exploratory, it was decided that ability in reading comprehension would provide the most appropriate characteristic for matching the participants in the first experiment since in the pilot study, this measure was the most sensitive to change following participation in the music intervention. Indeed gains in reading comprehension exceeded gains in other measures of reading capability in the successive experiments. Pair matching of the participants on reading comprehension scores, allowed conclusions drawn from the findings of these experiments to be attributed to the effects of the music intervention rather than to a confounding variable generated by uneven baseline scores.

Method for matching participants

Following the administration of the pre-tests in reading behaviour and any other measures such as measures of rhythmic discrimination, rhythmic performance, or balance, each participant was matched with another participant, according to their pre-test scores in reading comprehension. One participant in each pair was randomly assigned to the music intervention group, the other participant of that pair was randomly assigned to the control group. The reason for the random assignment of the participants to the experimental conditions, ensured that each participant had an equal chance of participating in the music intervention or in the control conditions. In Experiment 'A' the method for matching pairs was followed for reading comprehension pre-test scores and for rhythmic discrimination pre-test scores. Experiment 'A' was the first of the exploratory field experiments and initially it was decided that controlling for confounding variables in reading and rhythmic discrimination was appropriate.

Data for matched participants in the Field Experiments

Experiment 'A'

The data set out in Table 1 shows baseline mean scores and standard deviations in the measures of reading comprehension and rhythmic discrimination. In reading comprehension the mean baseline score for the music intervention was 44.79 and 48.96 for the control group. A mean baseline score of 46.88 was recorded overall. In the rhythmic discrimination measure, a mean baseline score of 77.08 was recorded overall. The mean baseline score for the intervention group was 77.50 and 76.67 for the control group. The baseline scores for reading comprehension and rhythmic discrimination are summarised in bar charts in Figures 1 and 2.

Table 1: A summary of the baseline scores for the sample in Experiment 'A'

	Intervention Group n = 12		Control Group n = 12		Overall n = 24	
Baseline measure	mean score	Std D.	mean score	Std D.	mean score	StdD.
Reading comprehension	44.79	29.42	48.96	26.36	46.88	27.40
Rhythmic discrimination	77.50	14.22	76.67	19.22	77.08	16.54

Fig. 1:Experiment A: baseline mean scores of reading comprehension for intervention and control groups.

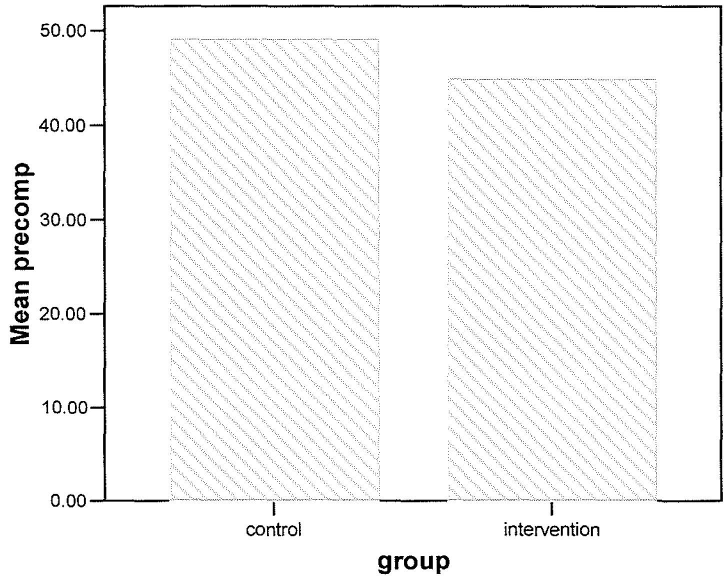
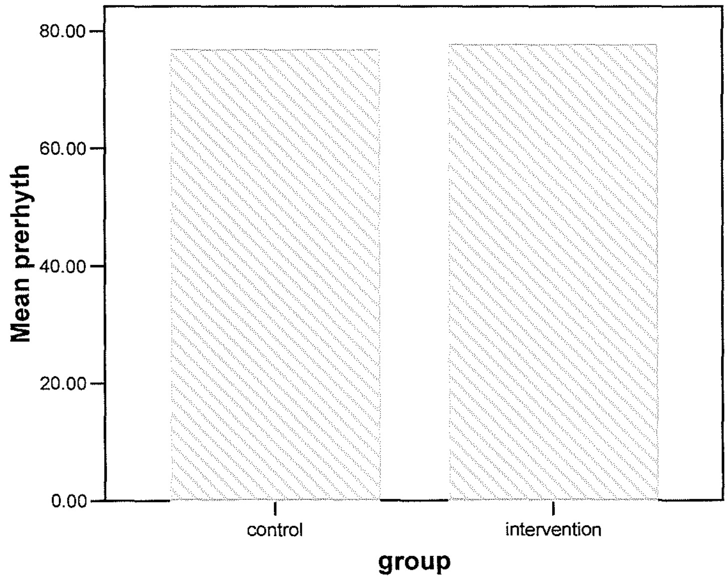


Fig. 2: Experiment A: baseline mean scores of rhythmic discrimination for intervention and control groups



Experiment 'B'

The data set out in Table 2 shows baseline mean scores and standard deviations in the measures of reading comprehension and rhythmic discrimination. In reading comprehension the mean baseline score for the music intervention group was 27.50 and 26.25 for the control group. A mean baseline score of 26.88 was recorded overall. In the rhythmic discrimination measure, a mean baseline score of 70.33 was recorded overall. The mean baseline score for the intervention group was 69.00 and 71.66 for the control group. The baseline scores for reading comprehension and rhythmic discrimination are summarised in bar charts in Figures 3 and 4.

Table 2: A summary of the baseline scores for the sample in Experiment 'B'

	Intervention Group n = 10		Control Group n = 10		Overall n = 20	
Baseline measure	mean score	Std D.	mean score	Std D.	mean score	StdD.
Reading comprehension	27.50	15.37	26.25	18.11	26.88	16.36
Rhythmic discrimination	69.00	12.48	71.66	11.57	70.33	11.79

Fig. 3:Experiment B: baseline mean scores of reading comprehension for intervention and control groups.

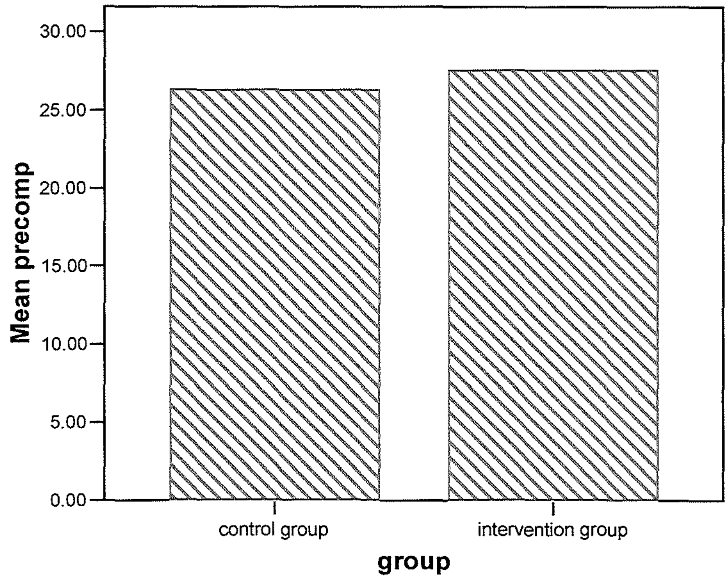
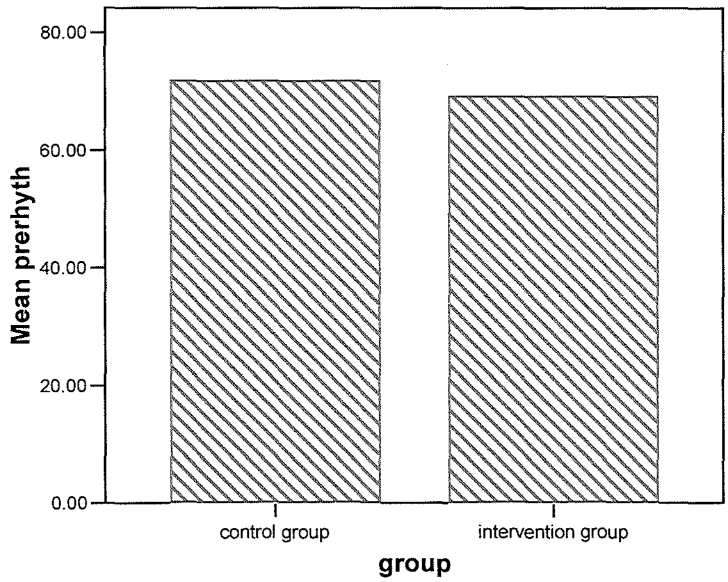


Fig. 4:Experiment B: baseline mean scores of rhythmic discrimination for intervention and control groups.



Experiment 'C'

The data set out in Table 3 shows baseline mean scores and standard deviations in the measures of reading comprehension and rhythmic discrimination. In reading comprehension the mean baseline score for the music intervention group was 29.89 and 26.13 for the control group. A mean baseline score of 28.06 was recorded overall. In the rhythmic discrimination measure, a mean baseline score of 49.30 was recorded overall. The mean baseline score for the intervention group was 52.33 and 46.14 for the control group. The baseline scores for reading comprehension and rhythmic discrimination are summarised in bar charts in Figures 5 and 6.

Table 3: A summary of the baseline scores for the sample in Experiment 'C'

	Intervention Group n = 12		Control Group n = 12		Overall n = 24	
Baseline measure	**mean score**	**Std D.**	**mean score**	**Std D.**	**mean score**	**StdD.**
Reading comprehension	**29.89**	**17.97**	**26.13**	**21.10**	**28.06**	**19.43**
Rhythmic discrimination	**52.33**	**30.93**	**46.14**	**24.93**	**49.30**	**28.02**

Fig. 5:Experiment C: baseline mean scores of reading comprehension for intervention and control groups.

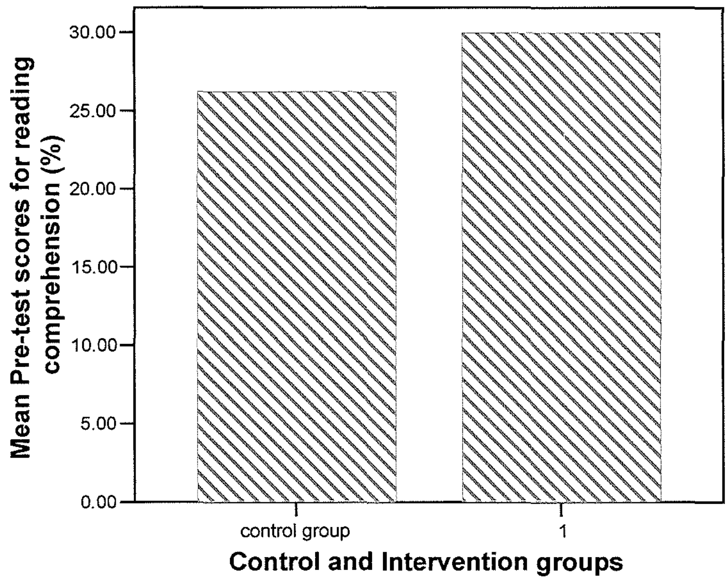
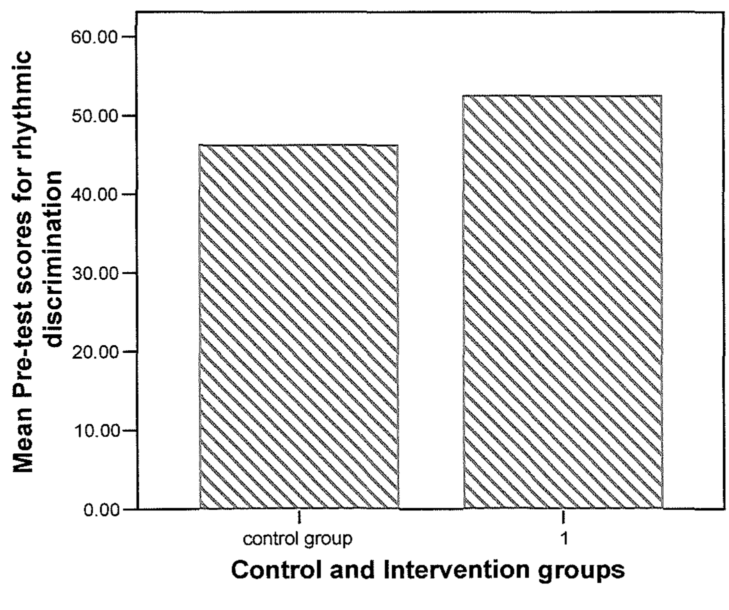


Fig. 6:Experiment C: baseline mean scores of rhythmic discrimination for intervention and control groups.



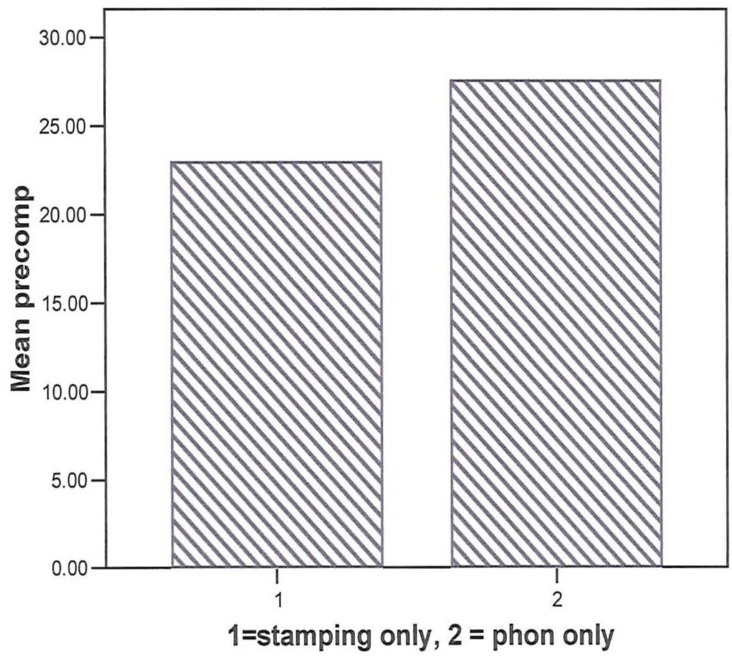
Experiment 'D'

The data set out in Table 4 shows baseline mean scores and standard deviations at Time 1 in the measure of reading comprehension. In reading comprehension the mean baseline score for the music intervention group was 22.91 and 27.50 for the phonological awareness training group. A mean baseline score of 25.00 was recorded overall. The baseline scores for reading comprehension at Time 1 are summarised in bar charts in Figure 7.

Table 4: A summary of the baseline scores at Time 1 for the sample in Experiment 'D'

	Music Intervention Group n = 6		Phonological Awareness Group n = 5		Overall n = 11	
Baseline measure	mean score	Std D.	mean score	Std D.	mean score	StdD.
Reading comprehension	22.91	22.94	27.50	20.54	25.00	20.91

Fig. 7: Experiment D: baseline mean scores of reading comprehension for the music intervention group and the phonological awareness training group.



Appendix V

Observations of an English Language Lesson: Year 5, reading group 2

9.00 Quiet reading session, there are 10 pupils in this class. One girl is sobbing. The teacher gives instructions in an abrasive tone: 'the aims of the lesson are: (i) to answer questions about the text, (ii) to read through the text, (iii) to answer questions about the text in full sentences'. A teacher's assistant helps one pupil with tricky words – a calming effect is achieved.

9.06 Six children have lost concentration. I have the impression they are not absorbed by the storyline of what they are reading.

9.09 Brain Gym.

9.10 Distributed books are opened. The paper is yellow to improve learning by reducing the black on white contrast which apparently creates glare. I look up, the light fixtures are very modern and produce harsh light. Frequent reminders by the teacher are abrasively reiterated with her emphasis on 'speed', 'focus' and 'time running out'. The situation feels quite stressful.

9.13 The pupils are motivated to do work. The class is very quiet.

9.14 Half the class is not focused.

9.16 Every child is fidgeting and whispering

9.17 A latecomer arrives and settles in, the teacher reiterates the three aims of the lesson.

9.19 A second latecomer arrives and settles in; again the teacher reiterates the three aims of the lesson.

9.20 The teacher makes the class aware of a sequence with which to approach their work: 'remember the sequence: read the text, read the questions, write the answers'.

9.21 The class respond by repeating the three aims of the lesson back to the teacher. Fidgeting becomes noticeable.

9.22 The teacher reminds the class to use a finger or a ruler or a pencil to assist with reading so that they do not lose their place in the text.

9.23 'M' reads. The syntax of the sentences she reads is in place and some expression is present but she falters frequently and makes phonetic mistakes.

9.24 'A' reads. The syntax of the sentences is not present in his reading. Friends prompt him.

9.25 The teacher reorganises the seating arrangements. This feels quite disruptive.

9.26 'B' reads. His reading is on a monotone but he displays lots of determination. He finds triple blends problematic (e.g. 'str') and cannot identify long vowels as vowel digraphs or in c.v.c.v. words.

9.27 The readers receive praise from the teacher. The class are told to look over the text. They whisper and fidget. The lack of continuity and poor quality of the reading demonstrations, means that it is unlikely that the rest of the class have absorbed or understood the text.

9.30 Two children are chosen to represent characters from the text. A window (as scenery) is drawn on the interactive white board by the teacher. The class responds in good humour to this task and joins in the actions that the characters make. There is some laughter and some silliness.

9.35 The teacher instructs the children to reference the text as she asks them comprehension questions. Inferential questions, although more complex, are not explained to the class.

9.36 The word 'abruptly' is defined by 'A'.

9.37 One of the 'actors' is not able to read their line from the text. The line is mumbled.

9.39 An inferential question is asked and it is answered by 'A'.

9.40 The teacher summarises the whole text and the main points from the lesson that she wants the class to remember. This sudden surge of information is demanding for any child that may have a short term memory deficit.

9.41 Brain Gym. The teacher reads comprehension questions from a yellow sheet aloud and asks the class to put their hands up if the know the answers. They are encouraged to confer with their partner.

9.43 'E' puts up his hand and offers the answer 'furious'. The teacher wanted him to find the word 'cross' as the key-word in the text. He is told to make a 'sentence answer' which he manages to do with some effort.

9.44 Fidgeting.

9.45 'T' returns to the class after his individual Brain Gym session.

9.46 Brain Gym

9.47 Some inferential questions are discussed but are not really understood.

9.49 'B' volunteers to answer a literal question and he answers correctly. Fidgeting intensifies.

9.50 Brain Gym

9.51 Calling out begins accompanied by more fidgeting.

9.52 The class are told to open their books. They are talking and fidgeting.

9.53 The noise level increases, some children are banging chairs. The teacher tells the class to 'do your best' as she distributes the yellow sheets with questions on them. There are enough for one copy to be shared between two children. The children are told to work in pairs.

9.54 'D' becomes agitated and fidgets. His helper writes 'his' answers for him.

9.55 Only 3 children are writing. The others are talking, walking around to get pencils or rubbers. Most of the children that are focused are rubbing out their work.

9.57 Now 7 children have just settled down to writing. The lesson stops.

Observations of an English Language Lesson: Year 6

10.10 'A' is praised for finishing her work. The class are engaged in silent reading. They fidget and start calling out. There are 14 in the class.

10.14 The teacher instructs them to take their book out and get ready to write. She tells the class to copy down today's date and the objectives of the lesson from the board. There are constant reminders to "stay on task". One boy asks if he can "keep it slow to do it neatly?" The teacher repeats the necessity to "stay on task". The class begin calling out again.

10.16 The teacher privately whispers to me that the class will be doing S.A.T.S. level 4 work which is too hard for them but that she needs to get the group prepared for these tests.

10.18 More calling out from the class, 'R' is named as he calls out. 'V' goes to the loo. The teacher is organising some power-point slides. Some children have not written down the objectives yet.

10.20 The teacher revises yesterday's storyline on the interactive white board. The class make contributions. 'B' is named as he fidgets.

10.24 The class have lost their focus, they fidget and have lost interest in the lesson. They look at me or straight ahead with glazed expressions. 'S' contributes, she is the only one doing so. The teacher's voice becomes highly abrasive but her words are encouraging.

10.26 'L' and 'R' try hard to join in. They have difficulty in forming sentences and as they speak and display a short – term memory deficit.

10.28 'L' calls out, his answer is correct. He appears to know what he wants to say but has difficulty in forming adequate sentences to express himself.

10.30 'L' has the correct answer again. 'V' is told by the teacher to "tune in". 'A' gets one question right and one question wrong. 'L' provides the correct answer, he calls out impulsively without putting out his hand.

10.31 'B' and 'N' both answer questions correctly. 'B' fidgets.

10.32 Brain Gym

10.34 The teacher asks the class to summarise the work they have just done. 'L' fidgets. 'S' suggests a good response.

10.35 The teacher asks the class another question and draws a picture on the interactive white board to give the class a clue as to where in the text they will find the answer.

10.36 The teacher instructs the class to do a writing task then tells them to close their eyes. The children think about how much help they might need and where they will sit to do this task. All the children move around the room to find different positions in the classroom where they will do the work. Two children sit next to me! All are fidgeting and talking.

10.40 The noise level rises. Many children fidget and talk. Only 4 are writing.

10.42 'A' and 'N' are told not to chatter. 'S' is focused. The teacher helps 'E'. The task is to write down the sequence of events in the story in the correct order.

10.45 'R' is wandering around the room.

10.46 The teacher stands at the front of the class and asks the class to run through the sequence of events in the story once again. 'B' answers correctly. 'B' is happier standing up while he writes. 'D' answers correctly. 'E' fidgets and bounces up and down.

10.47 'S' has now finished the task and is told to read ahead of the class. Six children are busy writing. Some are quietly discussing their work. 'R' is wandering around the classroom again.

10.50 The class are instructed to move back to their original positions in the room. Another reading session begins. 'L' returns to the room.

10.52 The teacher asks 'L' to read the number '12'. He answers that it is "20" then changes his mind and says "12"

10.53 'S' reads aloud on a monotone. She omits words and 's' sounds. Some punctuation is observed. She substitutes 'she' for 'we', 'plum' for 'pine'.

10.56 The class are instructed to confer and to decide what the events of the story were. 'R' offers an answer that is expansive and attempts to summarise some an idea of the thematic content without having the vocabulary to enable him to be successful 'J' invents an answer which he is told is "wrong". 'L' similarly is "wrong"; 'S' answers correctly twice.

11.01 The teacher instructs the class to "Jot down these answers using the references from the board". There are three events that occurred in the story to write down. Most of the class are writing. 'R' calls out about an unrelated matter which is ignored.

11.06 The class begin fidgeting and packing away. This initiative has brought the lesson to an unofficial end. 'B' stands up and begins throwing a ball.

Appendix VI

Phonological awareness training procedure

From Alpha to Omega: Phonological Awareness Training

Alpha to Omega is constructed to closely follow the normal pattern of phonological language acquisition. There are three stages in the programme. Stage One begins with knowledge of the alphabet and Stage Three includes polysyllabic words and the idiosyncrasies of final syllables such as 'cient' and 'cial'. The phonemes of the English language are available as a system of *Flashcards* for use as an intrinsic element of the Alpha to Omega programme.

There are Flashcards to accompany each Stage of the programme. For example, Flashcards appropriate to Stage One would include vowels, consonant blends such as '**spl**' or '**br**', consonant digraphs such as '**ch**' or '**ph**'. Flashcards that correspond to Stage Two would include vowel digraphs such as **'ai', 'oa', 'igh'.** In Stage Three, final syllable Flashcards are used **'sion', 'tion'** etc. The administration of the Flashcards is carefully prescribed as a 'Drill for teaching letters and their sounds'. The procedure as described in the programme is set out here.

The drill detailed below was adhered to as it constitutes a multi-sensory treatment that contrasts well with the stamping, clapping and chanting treatment. The participants were presented with each *flashcard* as individuals taking turn rather than as a group. This slower but more incisive approach was deliberately chosen to avoid any group response inducing an 'entrainment' effect similar to rhythmic chanting. Following the multi-sensory *flashcard* drill, word attack skills were addressed by putting sounds together utilising *onset and rime*. For example, the rime **'and'** may be combined with the onsets **'b', 'h', 'l'** etc. While these exercises perhaps appear very rudimentary, a lack of competency in word attack skills, is believed by many researchers described in Chapter Five to hinder reading development.

DRILL FOR TEACHING LETTERS AND THEIR SOUNDS

1. Teacher presents letter printed on flash card, with key word drawn on reverse side, saying its name.
2. Pupil repeats the name of the letter.
3. Teacher then says the key word and then the sound of the letter.
4. Pupil repeats key word and the sound of the letter.
5. Teacher says the sound without the key word.
6. Pupil repeats the sound without the key word and gives its name (translating sounds heard into letters written).
7. Pupil writes letter, copying from model, saying name as he writes it.
8. Pupil writes letter from memory.
9. Pupil reads what he has written giving the sound (translating letters written into sounds heard).
10. Pupil writes letter with eyes closed (enhancing kinaesthetic feedback when the visual channel is cut out).

    (Alpha to Omega Flashcards, 1999)

Appendix VII

Summary of Demonstration

Setting Up

You will need:

CD player within reach or remote control, CD of piano accompaniments to Stepping Stones, 2 reliable and sturdy music stands at children's eye level, Clothes pegs or clips to secure the music onto the music stands, 2 copies of Stepping Stones cello part, Water, cups etc, Approx 4 square metres of floor space, A clock or watch, Shoes or trainers need to be worn to protect the children's feet.

1. Set the music stands up with the Stepping Stones parts securely fixed on them.
2. Arrange 3 children around each music stand so that each can read the notes and move freely enough to stamp and clap.
3. Pre-test the CD so that stopping and starting the music will not cause a diversion during the flow of the session.
4. Ensure that the children drink water before and after but not during the session.

Stamping Together

1. Check that everybody has enough room to stamp 'on-the-spot',
2. The teacher begins to stamp (alternate feet) on-the-spot without musical accompaniment and the group copies the teacher exactly,
3. Check the group while they stamp for weaknesses and strengths,
4. A poorly coordinated child may need to spread their feet further apart,
5. An uncertain child will need the teacher to say 'lift... lift... lift...' etc, in time with the group's stamping,
6. A weak child may be placed next to a strongly coordinated child,
7. Keep a close eye on the quality of the stamping and maintain that this is always full of vitality but never uncontrolled,
8. Add clapping to the stamping. One clap for each stamp: turn slightly towards each stamping leg to help the clap match the stamp exactly,
9. Check that the quality of the stamping is not diminished by introducing clapping. If this happens, focus only on stamping until the stamping remains automatic when clapping is reintroduced.

Explaining notation

Point to the two copies of the 'cello music during the explanation and check for glazed expressions / confusion etc. Repeat the explanation until every child is secure. The sessions rely on the chanting of the correct answer and there is no time to work the note name out 'on the hoof'.

Some children may have learned the treble clef already. They can be told that this is a separate system for low instruments and that they must forget the treble clef notes that they already know for these sessions.

The success of the explanation is crucial to the success of the sessions. This is my own version of explaining notation and *so far* it has always worked.

1. Look at these musical notes (point to the first example).
2. They are made of blobs with sticks stuck on them, can you see? (Check for confusion; perhaps repeat point with detailed look at blob/ stick of one note)
3. We are going to look at the blob part and ignore the stick part. (Check for confusion again and ask them to repeat this point)
4. Each blob is sitting on a line. Are they sitting on the top line, the middle line or the bottom line? (Point to the lines on the stave)
5. (When all the children can see that the blobs are on the bottom line or the middle line): The bottom line note is called 'G'; the middle line note is called 'D' (Check for confusion).
6. Let's practise saying the note names (point to one or both sets of notes and move a finger along each line of notation chanting 'G! G! D! D! G! G! D! D!....' etc.

Structure of Stamping, Clapping and Chanting Sessions

1. Complete 'Setting Up' and invite the group to drink water.
2. Check the clock then begin with 'Stamping Together'
3. Do the 'Explaining Notation' talk and check for confusion with this.
4. Always start with the first exercise (i) chant the note names while you point, (ii) stamp, clap and chant with the music playing.
5. Progress through the exercises as detailed above. Always explain new notes. Each exercise is read together; the children stand still while they name the notes aloud as a group. The second reading is accomplished with the musical accompaniment and the stamping and clapping actions while the children read the note names aloud as a group.
6. Children that struggle with the activity must focus only on the stamping element until this is mastered. They must follow the notation as they other children chant the notes names, joining in with the group little by little.
7. After 8 minutes, return to the first exercise again and after this has been repeated by the group, invite volunteers to attempt a 'solo'.
8. Alternate 'solo' attempts with whole group attempts.
9. After 10 minutes the session is finished. Invite the group to drink water.

How to make the sessions work

Trust: The children who will benefit most from the exercises may find the exercises to be acutely embarrassing.

This is because their profound lack of inner coordination and integration will show through immediately. They will only manage to improve if they persevere. They will eventually achieve total integration and coordination naturally, provided they feel they are safe and supported by the group. There is no need to draw attention to the issue but sensitivity to their situation is essential.

Patience: Some children will find the exercises to be easy, and for them reading notation while stamping etc will be pure fun.

These children will enjoy progressing from one musical piece to another. As this happens others will lose confidence as the level of notation difficulty rises. Counteract this by returning to the very beginning again in the final stage of the session. A 'solo' volunteer from the group may be allowed some showing-off time. Usually a 'solo' attempt goes slightly wrong and this relaxes the anxiety levels of some of the other children who then become more confident. Gradually the differences in confidence between the children even out.

Encouragement: Some children will stamp very gently, clap with no energy and chant very timidly.

This is no good. It will achieve nothing. Impulses must always be strong and the teacher needs to constantly ask for energetic participation. Any sense of shyness or fear needs to be diffused by the child; warmth and encouragement from the teacher is essential to get these children moving properly. Usually, the predictable format of the sessions wins confidence from the inhibited children but they need to throw themselves into the activity or it will not work at all.

Boundaries: Some children will mask difficulties with coordination with disruptive behaviour while others are simply badly behaved.

Without good group cohesion, nothing will be achieved. If the sessions are ambushed by a poorly coordinated child, it will be worth working through the problem using very firmly structured sessions. 'Solo' opportunities for pure show-offs have worked in the past and have exposed them to feeling foolish while they have everybody's attention. Generally it's important to avoid interrupting the progress of the session. The aim is to focus for at least 8 minutes on the exercises without diversion.

Appendix VIII

Assessment Criteria for practical examinations of the
ASSOCIATED BOARD OF THE ROYAL SCHOOLS OF MUSIC

First published by Chief Examiner, Jean Harvey, 1982,
This edition published by Chief Examiner, Clara Taylor, 1998,
With amendments, 2001 and 2005.

With the kind permission of The Associated Board of The Royal Schools of Music

Assessment Criteria for Distinction (27 – 30)

Grades 6 - 8:

'Musically authoritative playing, showing a high level of technical assurance',

'Sensitive use of tonal qualities and rubato where appropriate',

'An instinctive and communicative sense of performance',

Grades 1 - 5:

'Technical fluency',

'Confident sense of performance and tonal control',

'Sensitivity to musical detail and mood',

'A musically convincing tempo',

Assessment Criteria for Merit (24 – 26)

Grades 6 – 8:

'Awareness of style shown by good use of dynamic range, shape of phrasing and rubato',

'Tonal control contributing to the musical character',

'A musically convincing tempo',

'Attention to the musical detail',

Grades 1 – 5:

'Attention to dynamics and phrasing',

'Evidence of tonal awareness and control',

'A suitable, sustained tempo',

'Sense of the character of the piece,'

'Good sense of rhythm,'

Assessment Criteria for Pass (20 – 23)

Grades 6 – 8:

'Overall security at a suitable and sustained tempo',

'Evidence of musical awareness, e.g. appropriate dynamics, phrasing, articulation',

Grades 1 – 5:

'General security of notes and rhythm',

'Suitable tempo',

'A reasonable sense of continuity',

'Evidence of careful preparation',

'Prompt recovery from any slips'

Assessment for Below Pass Standard I (17 – 19)

Grades 6 – 8:

'Just under the acceptable standard in general accuracy',

'A few slips or breaks in continuity',

'Absence of dynamics, phrasing or articulation',

'Unsuitable or unsustained tempo',

'Inappropriate style',

Grades 1 – 5:

'Just under the acceptable standard in general accuracy',

'Inadequate sense of continuity',

'Poor recovery from slips',

Assessment for Below Pass Standard II (13 – 16)

Grades 6 – 8:

'Serious difficulties with notes and / or time',

'Frequent stumbles and breaks in continuity',

'Halting or incomplete performance',

'Absence of musical detail',

'Serious lack of tonal control'

'Only some passages mastered',

Grades 1 – 5:

'Serious difficulties with notes and / or time',

'Frequent stumbles and breaks in continuity',

'Halting or incomplete performance',

'Serious lack of tonal control',

'Very weak in all respects',

Assessment for Below Pass Standard III (10 – 12)

Grades 6 – 8:

'Technically totally inadequate',

'Unable to continue for more than a short section without error',

Grades 1 – 5:

'Technically totally inadequate',

'Unable to continue for more than a few beats without error',

Assessment for Below Pass Standard IV (0)

Grades 6 – 8:

'No work offered',

Grades 1 – 5:

'No work offered',

Taylor, C. (2005, p. 39 - 40)

Appendix IX

Matrix: 'Analysis of Reading Fluency'
Participant 5 Time 1

Sentence	1	2	3	4	5	6	7	8	9	10	11	12
Level 1: Fluency Total score 5												
Systems of Key												
Logical sequences												
Functional words				*		*						
Inflectional endings												
Confident												
Sensitive to mood				*								
Communicative				*		*						
Pace reflects mood												
Level 2: Phrasing Total score 10												
Subject and predicate												
Tone group as information unit												
Pitch contour over tone group	*	*	*	*		*						
Tonic prominence on tonic foot or tonic syllable	*	*	*	*		*						
Sustained pace												
Level 3: Pre-phrasing Total score 34												
Reasonable continuity	*	*	*	*	*	*	*	*				
Overall security in decoding	*	*	*	*	*	*	*	*	*			
Prompt recovery from slips	*	*		*		*	*	*				
Presence of regular rhythmic foot		*		*		*						
Delineation of sentences	*	*	*	*	*	*	*	*	*			
Level 4: Pre-rhythm Total score 8												
Poor recovery from slips												
Lack of continuity									*			
Loses place on the page												
Monotone												
Inappropriate use of stress and pause	*	*	*		*		*	*	*			

Matrix: 'Analysis of Reading Fluency'
Participant 5 Time 2

Sentence	1	2	3	4	5	6	7	8	9	10	11	12
Level 1: Fluency Total score 5												
Systems of Key												
Logical sequences												
Functional words												
Inflectional endings	*		*	*		*	*					
Confident												
Sensitive to mood												
Communicative												
Pace reflects mood												
Level 2: Phrasing Total score 11												
Subject and predicate												
Tone group as information unit	*		*									
Pitch contour over tone group	*		*				*	*				
Tonic prominence on tonic foot or tonic syllable	*		*	*			*	*				
Sustained pace												
Level 3: Pre-phrasing Total score 21												
Reasonable continuity		*	*	*		*	*					
Overall security in decoding		*	*	*	*	*	*					
Prompt recovery from slips												
Presence of regular rhythmic foot			*				*	*				
Delineation of sentences	*	*	*	*		*	*	*				
Level 4: Pre-rhythm Total score 9												
Poor recovery from slips	*							*				
Lack of continuity	*				*			*				
Loses place on the page												
Monotone					*	*						
Inappropriate use of stress and pause					*	*						

Matrix: 'Analysis of Reading Fluency'
Participant 10 Time 1

Sentence	1	2	3	4	5	6	7	8	9	10	11	12
Level 1: Fluency Total score 0												
Systems of Key												
Logical sequences												
Functional words												
Inflectional endings												
Confident												
Sensitive to mood												
Communicative												
Pace reflects mood												
Level 2: Phrasing Total score 13												
Subject and predicate												
Tone group as information unit												
Pitch contour over tone group	*	*				*	*		*			
Tonic prominence on tonic foot or tonic syllable	*	*				*	*		*			
Sustained pace	*	*				*						
Level 3: Pre-phrasing Total score 24												
Reasonable continuity	*	*	*		*	*			*			
Overall security in decoding	*	*	*	*	*	*	*	*	*			
Prompt recovery from slips												
Presence of regular rhythmic foot						*						
Delineation of sentences	*	*	*		*	*	*	*	*			
Level 4: Pre-rhythm Total score 17												
Poor recovery from slips				*			*					
Lack of continuity				*			*					
Loses place on the page												
Monotone			*	*	*			*	*			
Inappropriate use of stress and pause	*	*	*	*	*		*	*	*			

Matrix: 'Analysis of Reading Fluency'
Participant 10 Time 2

Sentence	1	2	3	4	5	6	7	8	9	10	11	12
Level 1: Fluency Total score 0												
Systems of Key												
Logical sequences												
Functional words												
Inflectional endings												
Confident												
Sensitive to mood												
Communicative												
Pace reflects mood												
Level 2: Phrasing Total score 12												
Subject and predicate												
Tone group as information unit	*											
Pitch contour over tone group	*		*	*		*	*	*				
Tonic prominence on tonic foot or tonic syllable	*		*	*		*	*	*				
Sustained pace												
Level 3: Pre-phrasing Total score 19												
Reasonable continuity	*		*	*		*		*				
Overall security in decoding	*		*	*		*	*	*				
Prompt recovery from slips												
Presence of regular rhythmic foot												
Delineation of sentences	*	*	*	*	*	*	*	*				
Level 4: Pre-rhythm Total score 9												
Poor recovery from slips		*			*		*					
Lack of continuity		*			*		*					
Loses place on the page												
Monotone												
Inappropriate use of stress and pause		*		*	*							

Appendix X

Pilot Study of 'Analysis of Reading Fluency'

A pilot study was run using the data collected during Experiment 'D'. Unfortunately, the audio-data from the pre-tests that would have provided a base-line measure for the 'Analysis of Reading Fluency' were not available for analysis at this stage of the research. Data measuring reading behaviour at the end of Time 1 and the end of Time 2 were used.

The findings of the 'Analysis of Reading Fluency' indicated that particularly salient items: 'sentence delineation', 'inappropriate use of stress and pause', 'presence of a monotone', 'presence of a regular rhythmic foot', 'communicative voice', reflected changes in reading fluency specific to the participants of this experimental sample, as set out in Table 1. Each participant is listed twice so that intervention treatments received in Time One and Time Two intervention periods may be summarised.

The scores for each item, calculated by tallying the number of sentences in which an item occurred over the whole text, revealed variation in the length of texts and the number of texts attempted by some participants. For ease of comparison all the scores were converted to percentages. Three of the salient items are positive indicators of emergent prosodic reading; these are: 'sentence delineation', 'presence of a regular rhythmic foot' and 'presence of a communicative voice'. An increase in these scores indicated that reading fluency was developing. The remaining two salient items, 'inappropriate use of stress and pause' and 'presence of a monotone' constituted non-prosodic aspects of reading behaviour.

The 'Analysis of Reading Fluency', piloted here, requires demonstration so that the level of sensitivity and appropriateness of the measure may be considered. Table 1 functions as a summary of percentage scores derived from raw scores. The main objective of Table 1 is to detail the changes in reading fluency for the individual participants at the end of Time One and Time Two rather than providing descriptive statistics of mean scores and standard deviations straight away. The 'Salient Items' have been selected from the overall findings (see Appendix IX for some examples) as the items in which the participants were found to progress during the intervention. The changes in reading fluency scores for two participants are described below as a demonstration of interpretation of Table 1.

Two examples of assessment by the Analysis of Reading Fluency (see Table 1)

(i) Participant 5, following the participation in the music intervention, demonstrated reading fluency that consisted of all sentences being correctly delineated (100 per cent) although incorrect use of stress or pause was applied in the majority of sentences (78 per cent). The participant's voice was communicative at times (22.22 per cent) and a monotone was not detected at any point (0 per cent). A regular rhythmic foot was found in a third of the sentences read (33.33 per cent).

The same participant, following participation in the phonics intervention and the music intervention, performed better in some items but less well in others. Nearly all the sentences read were correctly delineated (87.50 per cent), but the number of incorrect applications of stress and pause was much reduced (25 per cent). Although a regular rhythmic foot was detected in some sentences, (33.75 per cent), a communicative voice was not found (0 per cent) and a monotone was found at times (25 per cent).

Overall, the same participant was found to demonstrate small changes in reading fluency for most items, except for a large improvement in the item 'inappropriate use of stress and pause'. This participant was assessed with a reading fluency of mostly 'Level 3' following both interventions. See Appendix IX for the Analysis of Reading Fluency raw scores.

(ii) Participant 10, following participation in the phonics intervention, demonstrated reading fluency that consisted of most sentences being correctly delineated (88.89 per cent), but in most sentences, stress and pause were used inappropriately (88.89 per cent). A monotone was recorded in more than half of the sentences read, (55.55 per cent) and the regular rhythmic foot was recorded rarely (11.11 per cent); a communicative voice was not demonstrated.

Following participation in the music intervention and the phonics intervention some improvement was found. All sentences were correctly delineated (100 per cent) and the rate of inappropriate use of stress and pause was reduced (37.50 per cent). The number of sentences read in a monotone disappeared completely. However, there was no evidence of a communicative voice (0 per cent) and the presence of a regular rhythmic foot was not recorded (0 per cent).

The Analysis of Reading Fluency assessments indicated progress towards 'Level 3' for this participant. See Appendix IX for 'Analysis of Reading Fluency' raw scores .

Table 1 The salient items of the 'Analysis of Reading Fluency'. Scores are measured as percentages of the text. For Level 4 * items, a high score indicates worse performance.

			Analysis of Reading Fluency Scores				
	Participant	Treatment	Level 4 Sentence Delineation	Level 4 * Inappropriate use of Stress & Pause	Level 4 * Presence of Monotone	Level 3 Regular Rhythmic Foot	Level 1 Communicative Voice
Time one:	1	Music	88.23	5.88	35.29	47.05	29.41
Time two:		Phonics	50	56.25	18.75	6.25	0
Time one:	2	Music	93.75	25	25	50	31.25
Time two:		Music & Phonics	81.25	25	0	93.75	0
Time one:	3	Music	88.24	52.94	23.53	58.82	29.41
Time two:		Phonics	87.50	62.50	12.50	18.75	0
Time one:	4	Music	75	62.50	75	25	0
Time two:		Music & Phonics	87.50	12.50	0	75	0
Time one:	5	Music	100	78	0	33.33	22.22
Time two:		Music & Phonics	87.50	25	25	37.50	0
Time one:	6	Music	55.55	88.88	0	33.33	0
Time two:		Music & Phonics	100	87.50	0	75	0
Time one:	7	Phonics	100	0	0	50	37.50
Time two:		Phonics & Music	100	18.75	0	62.50	6.25
Time one:	8	Phonics	100	0	5.88	58.82	47.06
Time two:		Music	100	12.50	0	62.50	25
Time one:	9	Phonics Extra	87.50	0	0	50	0
Time two:		Phonics & Music	50	25	12.50	87.50	0
Time one:	10	Phonics Extra	88.89	88.89	55.55	11.11	0
Time two:		Phonics & Music	100	37.50	0	0	0
Time one:	11	Phonics Extra	0	100	28.57	0	0
Time two:		Phonics & Music	75	25	12.50	37.50	0

Pilot Study ~ Results for the 'Analysis of Reading Fluency'

In this part of the research, the null hypothesis was that following participation in the music intervention, there would be no gain in the rhythmic aspect of reading fluency and no gain in reading comprehension score. Unfortunately, the baseline scores for Experiment 'D' collected at the beginning of 'Time One' were not available for analysis. For this reason, change scores in reading behaviour were not presented, but end scores collected at the end of 'Time One' and 'Time Two' describing means and standard deviations for the salient items of the 'Analysis of Reading Fluency' and reading comprehension were collected and analysed, as shown in Table 2. The analytical component of the findings is set out in Tables 3 and 3A, followed by correlations and mini-case studies.

Table 2: Descriptive statistics as mean scores and their standard deviations for salient items from the Analysis of Reading Fluency.

		Group and sample size					
Reading behaviour end scores		1 n = 7	2 n = 7	3 n = 5	Overall n = 19	3A n = 8	Overall n = 22
Reading Comprehension	**Mean**	43.72	33.93	70.00	48.35	56.25	46.31
	Std D.	22.49	27.68	25.92	28.02	29.12	27.12
Sentence Delineation	**Mean**	85.82	73.41	91.25	82.68	85.16	81.63
	Std	15.86	36.49	8.39	24.51	17.01	24.12
Appropriate use of stress and pause	**Mean**	55.06	55.05	66.25	58.37	67.97	60.07
	Std. D.	30.33	43.68	30.49	34.25	23.49	32.09
Absence of a monotone	**Mean**	77.31	82.68	95.00	83.94	93.75	85.00
	Std. D.	27.22	19.77	11.18	29.37	9.45	20.09
Presence of a regular rhythmic foot	**Mean**	44.29	27.85	68.75	44.67	58.59	57.90
	Std. D.	14.11	24.31	20.73	25.10	31.51	67.99
Communicative voice	**Mean**	19.61	12.08	1.25	12.01	0.78	10.37
	Std. D.	13.74	20.81	2.79	16.24	2.21	15.61

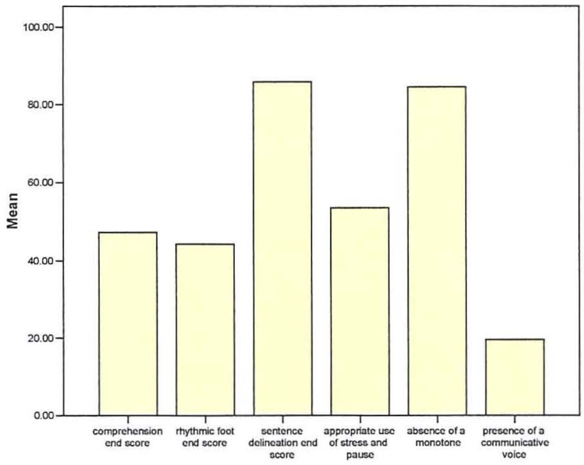
The first column 'Group' refers to the experimental treatment groups described earlier, and also in Chapter Five. These are summarised as follows:

Group 1 participated in the music intervention in 'Time 1'.
Group 2: received 5-7 weeks phonological awareness treatment, including 5 participants from 'Time 1' and 2 participants from 'Time 2'.
Group 3: participated in both 5-7 weeks of phonological awareness training and the music intervention in Time '2'.
Group 3A: participated in up to 10 weeks phonological awareness training and the music intervention in 'Time 2'. Group 3 participants are also in Group 3A.

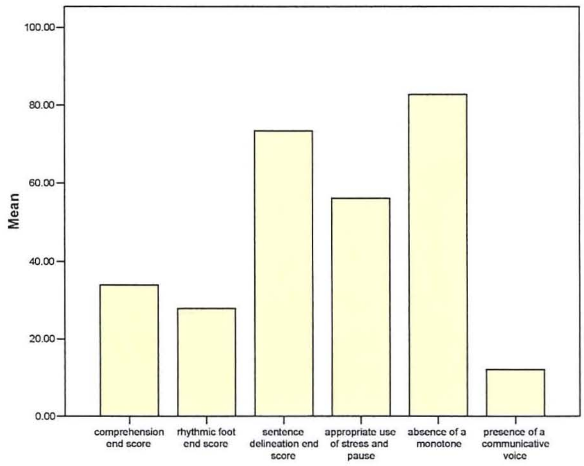
The data summarised in Table 2 is also presented in Figure 1. The four graphs illustrate reading comprehension end scores and mean end scores for the salient items of the 'Analysis of Reading Fluency' for Group 1, Group 2, Group 3 and Group 3A. The graphs show similarities and differences between mean end scores following participation in different interventions and combinations of interventions. Group 1 and Group 2 were matched for reading comprehension baseline scores at the start of 'Time 1'.

Figure 1 End scores of reading behaviour

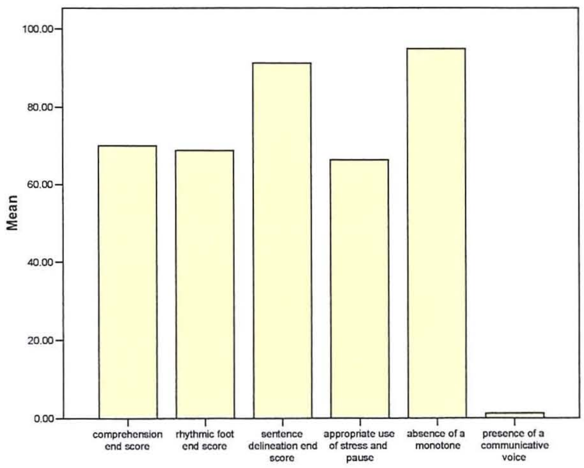
Summary for Group 1: music intervention



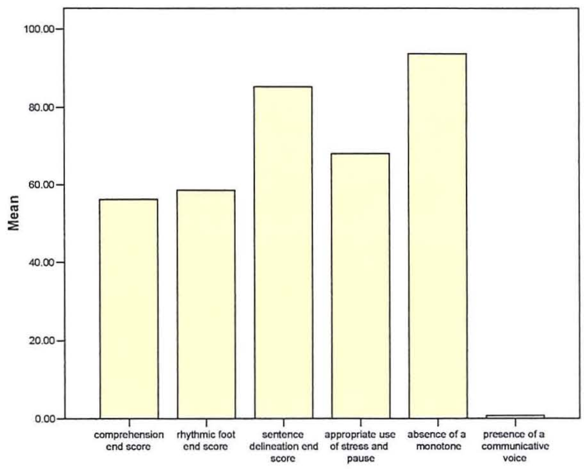
Summary for Group 2: phonics intervention



Summary for Group 3: both music intervention and phonics intervention



Summary for Group 3A: music and up to 10 weeks of phonics intervention



The bars from left to right represent end scores for:

- **reading comprehension**
- **presence of a regular rhythmic foot**
- **sentence delineation**
- **appropriate use of stress and pause**
- **absence of a monotone**

- **presence of a communicative voice**

The reading comprehension mean end score for Group 1 that participated in the music intervention was 47.32. This was higher than 33.93, the mean end score for Group 2 that received 5-7 weeks of phonological awareness training. Group 3 received 5-7 weeks of phonological awareness training and the music intervention, and had the highest mean end score of 70.00 in reading comprehension. Similarly, Group 3A that participated in the music intervention and up to 10 weeks of phonological awareness training had a mean end score of 56.25 in reading comprehension.

A similar pattern is found in the results for the item, 'presence of a regular rhythmic foot' where the mean scores for Group 1: 44.29 (that received the music intervention), and Group 2: 27.85 (that received 5-7 weeks of phonological awareness training) were exceeded by the mean scores for Group 3 and Group 3A. The mean score for Group 3: 68.75 (that received the music intervention in addition to 5-7 weeks of phonological awareness training) was higher than the mean score for Group 3A: 58.59 (that received up to 10 weeks of phonological awareness training in addition to the music intervention).

The 'sentence delineation' mean for Group 1 (that received the music intervention) was 85.82. The Group 1 mean score was higher than the Group 2 mean score: 73.41 (that received 5-7 weeks of phonological awareness training). The mean score for Group 3: 91.25, (that received 5-7 weeks of phonological awareness training in addition to the music intervention), exceeded the mean scores for Group 1 and Group 2. Group 3A (received up to 10 weeks of phonological awareness training combined with the music intervention); had a mean score of 85.16, higher than the mean score for Group 2 and commensurate with the mean score for Group 1.

The 'appropriate use of stress and pause' mean score for Group 1: 56.06 (that received the music intervention) was commensurate with the mean score for Group 2: 56.05 (that received 5-7 weeks of phonological awareness training). Group 3 (received both the music intervention and phonological awareness training for 5-7 weeks) had a higher mean score: 66.25. The highest mean score was found for group3A: 67.97 (that received up to 10 weeks of phonological awareness training as well as the music intervention).

For the item, 'absence of a monotone', the mean score for Group 1: 77.31 (that received the music intervention only), was exceeded by the mean score of Group 2: 82.68 (that received 5-7 weeks of phonological awareness training). Both of these mean scores were exceeded by the mean score of Group 3: 95.00, (which received 5-7 weeks of phonological awareness training in addition to the music intervention). The mean score for Group 3 was slightly higher than the mean score for Group 3A: 93.75 (that received up to 10 weeks of phonological awareness training in addition to the music intervention).

Nearly all the participants were weak in the 'presence of a communicative voice' item; the scores are low for each group. The mean score for Group 1: 19.61 (that received the music intervention) was the highest mean score overall. The group that received 5-7 weeks phonological awareness training, Group 2, had a lower mean score: 12.08. The mean score for Group 3: 1.25 (that received 5-7 phonological awareness training and the music intervention) was substantially lower than the mean scores for Groups 1 and 2. The lowest mean score was found for Group 3A: 0.78 (that received up to 10 weeks of phonological awareness training and the music intervention).

Summary

From the mean end scores presented in Table 2 and the bar charts in Figure 1, a trend in the predicted direction appeared to have occurred in Group 1 and particularly Group 3. Following participation in the music intervention, mean end scores indicated rhythmic aspects in reading behaviour, and levels of reading comprehension appeared to be greater than the equivalent mean end scores in reading behaviour following participation in the phonological awareness intervention (Group 2). To explore between group differences in mean end scores in reading behaviour further, analyses were conducted between Group 2, that participated in 5-7 weeks of phonological awareness training and Groups that participated in the music intervention: Group 1, Group 3 and Group 3A.

Findings of Multivariate Analyses of Variance

Differences in the mean end scores between Group Two and the Groups that participated in the music intervention (Groups 1, 3 and 3A) suggested a trend that tests the null hypothesis: following participation in the music intervention there would be no gain in the rhythmic aspect of reading fluency and no gain in reading comprehension. Since baseline scores in reading fluency were not available from Time 1, it was not possible to test for differences in change scores in reading fluency for Group 1 or Group 2.

In Table 3 differences in reading behaviour end scores between Group 1 and 3 overall that participated in the music intervention and up to 7 weeks of phonological awareness training and Group 2 that participated in 5-7 weeks of phonological awareness training but not the music intervention were compared. In Table 3A the same analysis was repeated but the participants from Group 3A were included. Therefore differences in reading behaviour end scores between Groups 1 and 3A overall that received up to 10 weeks of phonological awareness training and the music intervention, and Group 2 that received 5-7 weeks of phonological awareness training but not the music intervention were compared.

According to Dancey and Reidy (2004, p. 488) the assumptions for conducting a multivariate analysis of variance are that the dependent variables are normally distributed, sample sizes in each group are equal and $n > 12$ in each group. In the following analyses, these assumptions are not met. To safeguard against error, Levene's Test of Equality was employed to test whether error variance was equal across the groups. Box's M was employed to test whether the dependent variables co-varied equally under the conditions of unequal sample sizes. In both analyses set out here, Box's M was satisfied. In both analyses, Levene's Test of Equality was satisfied in all dependent variables except for 'sentence delineation' which can be demonstrated by noting the very high standard deviation score in Group 2.

Statistically Significant Effect

In Table 3, a statistically significant effect was found for the dependent variable 'presence of a regular rhythmic foot'. p = .021 favoured the Groups 1 and 3 participants that had received up to 7 weeks of phonological awareness treatment and the music intervention. The 'presence of a regular rhythmic foot' mean end score for the participants in Groups 1 and 3 overall was 54.48 and the mean end score for the participants in Group 2 that received 5-7 weeks of phonological awareness training but not the music intervention was 27.85. The mean end score for the overall sample for 'presence of a regular rhythmic foot' was 44.67. No statistically significant effects were found for the other five dependent variables.

Table 3
A multivariate anova for reading behaviour end scores between Groups 1 & 3 (up to 7 weeks phonics training plus music intervention) and Group 2 (5-7 weeks phonics training only)

Reading behaviour end scores as percentages	Group	n	Mean	Std. D.	df	F	*Sig.*
Reading comprehension	1& 3	12	56.77	25.63			
	2	7	33.92	27.68	1	3.317	Ns
	total	19	48.36	28.02			
Regular rhythmic foot	1& 3	12	54.48	20.58			
	2	7	27.85	24.31	1	6.498	.021
	total	19	44.67	25.10			
Sentence delineation	1& 3	12	88.09	13.06			
	2	7	73.41	36.49	1	1.641	ns
	total	19	82.68	24.51			
Appropriate use stress and pause	1& 3	12	58.80	30.97			
	2	7	56.05	43.69	1	.026	ns
	total	19	57.78	34.99			
Absence of a monotone	1& 3	12	88.85	14.08			
	2	7	82.69	19.78	1	.629	ns
	total	19	86.58	16.51			
Presence of a communicative voice	1& 3	12	11.96	13.97			
	2	7	12.08	20.81	1	.000	ns
	total	19	12.01	16.24			

Consistent with Table 3, a similar statistically significant effect was found in Table 3A for the dependent variable 'presence of a regular rhythmic foot'. p = .048 favouring the participants of Groups 1 and 3A that had received up to 10 weeks of phonological awareness treatment and the music intervention. The 'presence of a regular rhythmic foot' mean end score for the participants in Groups 1 and 3A overall was 51.92 and the mean end score for the participants in Group 2 that received 5-7 weeks of phonological awareness training but not the music intervention was 27.85.The mean end score for the total sample was 44.26. Consistent with Table 3 there were no statistically significant effects found for the other five dependent variables.

Table 3A
A multivariate ANOVA for reading behaviour end scores between Groups 1 & 3A (up to 10 weeks phonics training plus music intervention) and Group 2 (5-7 weeks phonics training only)

Reading behaviour end scores as percentages	Group	n	Mean	Std. D.	df	F	*Sig.*
Reading comprehension	1& 3A	15	52.08	25.73			
	2	7	33.92	27.68	1	2.268	ns
	total	22	46.31	27.12			
Regular rhythmic foot	1& 3A	15	51.92	25.22			
	2	7	27.85	24.31	1	4.442	.048
	total	22	44.26	26.92			
Sentence delineation	1& 3A	15	85.47	15.90			
	2	7	73.41	36.49	1	1.204	ns
	total	22	81.63	24.12			
Appropriate use stress and pause	1& 3A	15	61.20	28.03			
	2	7	56.05	43.69	1	.113	ns
	total	22	59.56	32.70			
Absence of a monotone	1& 3A	15	89.41	12.83			
	2	7	82.69	19.78	1	.926	ns
	total	22	87.27	15.22			
Presence of a communicative voice	1& 3A	15	9.57	13.33			
	2	7	12.08	20.81	1	.118	ns
	total	22	10.37	15.61			

Findings in Tables 3 and 3A across the groups in reading comprehension and 'presence of a regular rhythmic foot', suggested that these two dependent variables may co-vary. The mean end scores for reading comprehension and 'presence of a regular rhythmic foot' were compared in a correlations. Graphical summaries of the findings are set out in figure 2 and figure 3. The bars show end scores for each reading sample for reading comprehension scores (blue) and the presence of the regular rhythmic foot (green). Each pair of bars represents an experimental Group.

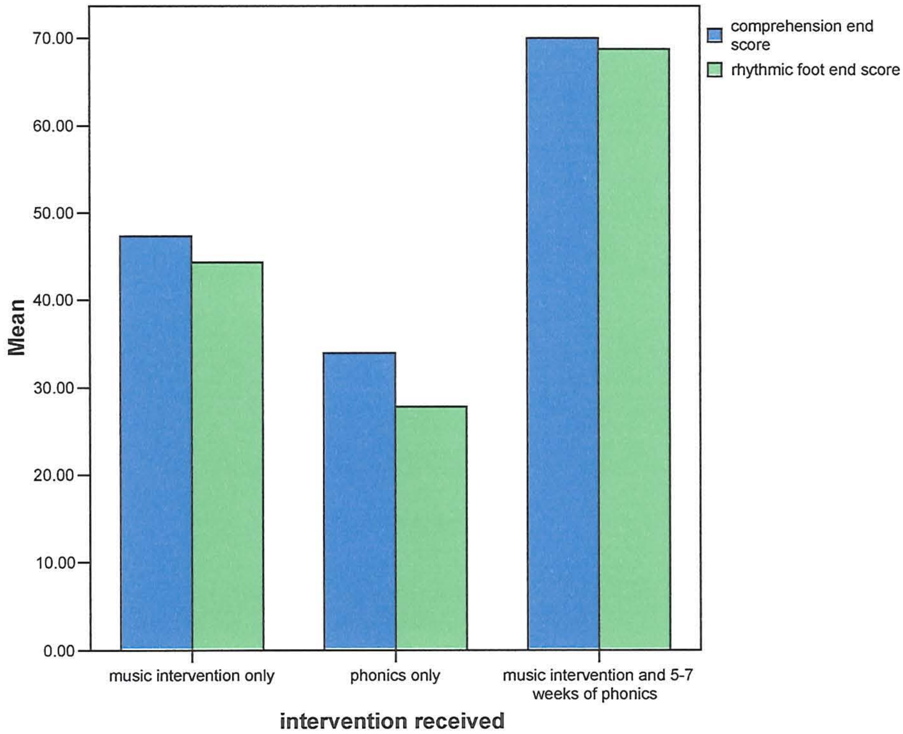


Fig. 2 Summary of reading comprehension and 'presence of a regular rhythmic foot' in mean end scores for Groups 1, 2 and 3

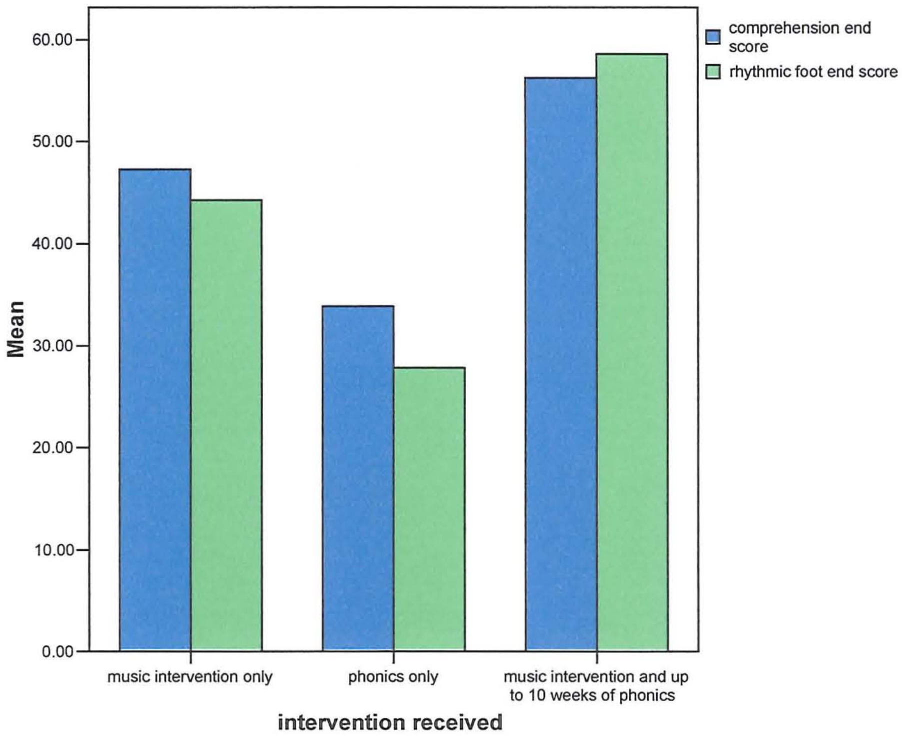


Fig. 3 Summary of reading comprehension and 'presence of a regular rhythmic Foot' in mean end scores for Groups 1, 2 and 3A

From the bar charts (figs 2 and 3) the two sets of mean end scores, reading comprehension and 'presence of a regular rhythmic foot', were observed to co-vary in each Group. This observation suggested further investigation between into co-variance between the mean end scores in reading fluency and the mean end scores of reading comprehension.

It was decided that due to the small sample sizes correlations would be carried out on the overall sample. Separate correlations were conducted for two overall combinations of participant Groups (Groups 1, 2, 3 and Groups 1, 2, 3A) to distinguish between the sample overall that had received 5-7 weeks of phonological awareness training and for the sample overall that had received up to 10 weeks phonological awareness training. Therefore data from the six correlations were combined to provide the information presented as findings in Table 4 and Table 5. The degree of covariance between end scores for reading comprehension and the five salient items from the 'Analysis of Reading Fluency' (including 'presence of the regular rhythmic foot') was tested using Pearson's *r*. Table 4 summarizes the findings of the correlations between mean end scores of salient items of the 'Analysis of Reading Fluency' and reading comprehension mean end scores for all Groups.

Reading comprehension x 'sentence delineation'

Across Groups 1, 2, and 3 strong or medium correlations were found between reading comprehension and 'sentence delineation'. Highly statistically significant findings (r = .662, p = .004) for all the participants at the end of Time 2 from Groups 1,2 and 3 overall and highly statistically significant findings (r = .612, p = .002) for all of the participants at the end of Time 2 for Groups 1, 2 and 3A overall were found. These findings indicated that over the whole sample, reading comprehension is related to 'sentence delineation', significant at the 1% level.

Reading comprehension x 'appropriate use of stress and pause'

Statistically significant effects (r = 662, p = .002) were found overall for participants that had participated in Groups 1,2 and 3 at the end of Time 2. The overall finding for all participants in Groups 1, 2 and 3A was significant at the 1% level (r = 587, p = .004); this indicated that for all participants at the end of Time 2 reading comprehension was moderately related to 'appropriate use of stress and pause'.

Reading comprehension and 'absence of a monotone'

Weak correlations were found across all Groups between reading comprehension and 'absence of a monotone' mean end scores. There were no statistically significant effects between these two variables. This finding supported the null hypothesis of no relationship between the 'absence of a monotone' and reading comprehension.

Reading comprehension and 'presence of a regular rhythmic foot'

Analyses of the sample overall produced statistically significant findings at the 1% levels for both the participants from Groups 1, 2 and 3 (r = .740, p = 001) and from Groups 1, 2 and 3A ($r =$ .591, $p = .004$). A significant effect for a strong positive relationship between reading comprehension and 'presence of a regular rhythmic foot' is indicated by the overall findings.

Reading comprehension and 'presence of a communicative voice'

Very low correlations were found in the overall end scores for Groups 1, 2 and 3 similarly for overall end scores of Groups 1, 2 and 3A. A relationship between reading comprehension and 'presence of a communicative voice' was not suggested by these findings.

Table 4 Correlations between items from the 'Analysis of Reading Fluency' and reading comprehension

Reading Behaviour (end scores)		Groups 1, 2, 3 n = 19	Groups 1, 2, 3A n = 22
Sentence delineation	**Pearson Correlation**	.630**	.612**
	Sig. (2 tailed)	.004	.002
Appropriate use of stress and pause	**Pearson Correlation**	.662**	.587**
	Sig. (2 tailed)	.002	.004
Absence of a monotone	**Pearson Correlation**	.334	.315
	Sig. (2 tailed)	NS	NS
Presence of a regular rhythmic foot	**Pearson Correlation**	.740**	.591**
	Sig. (2 tailed)	<.001	.004
Communicative voice	**Pearson Correlation**	.135	.177
	Sig. (2 tailed)	NS	.431

Correlations

** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Brief Discussion

The exploration of the possibility of a relationship between reading comprehension and rhythmic aspects of reading fluency for this sample continued by summarizing the data from the six correlations describing the covariance between 'presence of a regular rhythmic foot' end scores and the other salient items of reading fluency. The rational for this exploration drew on Halliday's (1985) position that pedalian rhythm (regular rhythmic foot) is 'the rhythmic unit of the English language' (ibid). The findings are summarized in Table 5 and are described here.

'Presence of a regular rhythmic foot' x 'sentence delineation'

For the participants from Groups 1, 2 and 3 overall, a moderate positive correlation (r = .594, p = .007) recording a statistically significant effect at the 1% level occurred. However, these findings are contrasted by a statistically non significant weak positive correlation found for Groups 1, 2 and 3A overall. This inconsistent finding might be due to sampling error from between participant variation in the three participants that belong to Group 3A but not Group3.

'Presence of a regular rhythmic foot' x 'appropriate use of stress and pause'

A mostly consistent relationship was found between 'presence of a regular rhythmic foot' and 'appropriate use of stress and pause'. For the participants from Groups 1, 2 and 3 overall, a moderate positive correlation was found over the three Groups, this was statistically significant at the 5% level (r = .558. p = .013). Similarly, across the participants of Groups 1, 2 and 3A overall, a moderate positive correlation was found to be statistically significant (r = .498, p = .018).

'Presence of a regular rhythmic foot' x 'absence of a monotone'

Moderate positive correlations were found across the Groups overall. The overall correlation across Groups 1, 2, and 3 produced a statistically significant effect (r = .579, p = .009) at the 1% level. Similarly, across Groups 1, 2 and 3A a statistically significant effect (r = .426, p = .048) for the mean end scores overall was found at the 5% level. Therefore, in general a moderate positive relationship may be identified between 'absence of a monotone' and 'presence of a regular, rhythmic foot' for this sample.

<u>'Presence of a regular rhythmic foot' x 'presence of a communicative voice'</u>

Weak positive correlations were found for Groups 1, 2 and 3 overall (r = .249, p = ns) and for Groups 1,2 and 3A overall (r = .217, p = ns) with no statistically significant effects.

Table 5 Correlations between 'presence of a regular foot' and other items from the 'Analysis of Reading Fluency'.

Reading behaviour (end scores)		Groups 1, 2, 3 n = 19	Groups 1, 2, 3A n = 22
Sentence delineation	Pearson Correlation	.594**	.326
	Sig. (2 tailed)	.007	NS
Appropriate use of stress and pause	Pearson Correlation	.558*	.498*
	Sig. (2 tailed)	.013	.018
Absence of a monotone	Pearson Correlation	.579**	.426*
	Sig. (2 tailed)	.009	.048
Communicative voice	Pearson Correlation	.249	.217
	Sig. (2 tailed)	NS	NS

Correlations

** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

<u>Summary</u>

Small samples have been used in this pilot of the Analysis of Reading Fluency'. Therefore sampling error might account for a large number of the strong correlations presented in Tables 4 and 5. Nevertheless, with only a small sample, a number of the correlations have been identified as statistically significant. Statistically significant effects have been found in Table 4 between reading comprehension end scores and the salient items of the 'Analysis of Reading Fluency' and also in Table 5 which explored internal relationships within the 'Analysis of Reading Fluency'.

Elements of reading behaviour, described as salient items in the 'Analysis of Reading Fluency' and discussed in relation to reading comprehension, initially theoretically and then empirically through correlations, are also illustrated in two case studies presented here.

Case Study ~ An illustration of findings for the 'Analysis of Reading Fluency'

In Experiment 'D', participant 4 (see CD, Track 2) 'Analysis of Reading Fluency' scores are set out in Table 6. This participant was in Group 1, assigned to the music intervention in treatment period Time One, and Group 3 for Time 2. A quiet, reserved child, she found the music intervention unpleasant; her actions were limp and lifeless. Stamping in time was very difficult for her. A great deal of encouragement and support was needed before she felt confident enough to increase the effort she put into the activity. After 10 weeks, participant 4 achieved competence in the music intervention activity to an extent that suggested 'temporal integration' probably occurred.

Table 6. An illustration of 'Analysis of Reading Fluency' scores and 'Neale Analysis of Reading' scores for participant 4 (Group 3) from Experiment 'D'. Rate of Reading is given as words per minute but all other items are given as percentages.

End scores Participant 4	Absence of a monotone	Appropriate Use of Stress and Pause	Presence of a Regular Rhythmic Foot	Reading Compre-hension score	Reading Accuracy score	Reading Rate score
Time 1	**25.00**	**37.50**	**25.00**	**12.50**	**0**	**75.30**
Time 2	**100.00**	**87.50**	**75.00**	**75.00**	**6.25**	**60.50**

In Table 6, the end scores for participant 4, illustrated that the salient items of 'Analysis of Reading Fluency' correspond with reading comprehension scores but not reading accuracy scores, using reading samples collected at the end of Time 1 and Time 2 of Experiment 'D'.

The Time 1 reading comprehension end score was 12.50 and following Time 2, this increased to 75.00. A similar gain was found for 'presence of a regular rhythmic foot' with a Time 1 end score of 25.00 that increased to 75.00. At the end of Time 1, participant 4 had a low score for 'absence of a monotone'. This score increased to the point where the monotone disappeared completely. The low incidence of 'appropriate use of stress and pause' 37.50 improved following participation in the music intervention to the point at which this level of temporal organisation was much more reliable, with a 87.50 end score. Although many improvements in reading fluency were recorded, reading accuracy was only slightly improved. The Time 1 end score of 0 increased to 6.25 at the end of Time 2. The rate of reading decreased at the end of Time 2, perhaps forming an inverse relationship with the gain in reading comprehension end score.

In Experiment 'D', participant 11's 'Analysis of Reading Fluency' scores are set out in Table 7. This participant was in Group 2, assigned to the phonics intervention in the treatment period corresponding with Time One, and Group 3A for Time 2. In Time 2 participant 11 was absent for the first session and suffered from an injured ankle in the second session. This meant that he was unable to participate energetically in the music intervention until the third session. He picked up the idea quickly though and developed some confidence in the remaining sessions. Although he responded to encouragement, participant 11 was not energetic in his approach but he retained his quietly confident engagement with the music intervention. In the phonics intervention this participant demonstrated weakness in discriminating between vowel phonemes both in reading and speaking.

In Table 7, the end scores for participant 11, illustrated that the salient items of 'Analysis of Reading Fluency' correspond with reading comprehension scores but not reading accuracy scores, using reading samples collected at the end of Time 1 and Time 2 of Experiment 'D'.

The Time 1 the reading comprehension end score was 0 and following Time 2, this increased to 25.00. A similar gain was found for 'presence of a regular rhythmic foot' with a Time 1 end score of 0 indicating a complete absence of the 'presence of a regular rhythmic foot' that improved to 37.50. At the end of Time 1, participant 11 had a good score for 'absence of a monotone' of 71.43. This score increased to 87.50 indicating that the monotone became further reduced. The complete absence of 'appropriate use of stress and pause' improved following participation in the music intervention to the point at which this level of temporal organisation was established in a greater proportion of sentences giving a 75.00 end score. Although varying improvements in reading fluency were recorded, reading accuracy demonstrated a deterioration. This may be accounted for by considering external variables or perhaps, this participant's reading was in a process of transition which impacted negatively on reading accuracy strategies and processes. The Time 1 end score of 50.00 decreased to 32.25 at the end of Time 2.

Table 7: An illustration of 'Analysis of Reading Fluency' scores and 'Neale Analysis of Reading' scores for participant 11 (Group 3A) from Experiment 'D'. Rate of Reading is given as words per minute but all other items are given as percentages.

End scores participant 11	Absence of a monotone	Appropriate use of stress and pause	Presence of a regular rhythmic foot	Reading compre-hension score	Reading accuracy score	Reading rate score
Time 1	71.43	0	0	0	50.00	81
Time 2	87.50	75.00	37.50	25.00	32.25	68.4

In keeping with the changes in reading behaviour of the case study of participant 4, the rate of reading for participant 11 decreased at the end of Time 2, perhaps supporting the proposed inverse relationship with the gain in reading comprehension end score.

It is likely that participant 11 would benefit from further exposure to the music intervention. He achieved improvements in elements of reading behaviour predicted by the theory detailed earlier in this chapter but with further exposure to the music intervention, it is argued that he would make further improvement in reading fluency and reading comprehension.

These case studies illustrate findings consistent with the overall findings in changes in reading behaviour following participation in the music intervention, combined with 5-7-weeks of phonological awareness training. A decreased score in rate of reading accompanied by an increased score in reading comprehension was also found for some participants in Experiment 'B' and Experiment 'D'.

Discussion of findings in the Pilot Study

The 'Analysis of Reading Fluency' was piloted using reading samples collected in Experiment 'D'. Five salient items were found to indicate levels of the fluency of reading behaviour for this particular sample: 'sentence delineation', 'appropriate use of stress and pause', 'absence of a monotone', 'presence of a regular rhythmic foot', 'presence of a communicative voice'.

Following between group analyses, statistically significant effects were found in 'presence of a regular rhythmic foot' in a multivariate analysis of variance of end scores between Group 2 that participated in 5-7 weeks of phonological awareness training and participants from Groups 1 & 3 that participated in both 5-7 weeks of phonological awareness training and the music intervention. Similarly, a statistically significant effect was found in 'presence of a regular rhythmic foot' in a MANOVA of mean end scores of reading behaviour for the participants of Group 2 and the participants of Groups 1 and 3A that participated in up to 10 weeks of phonological awareness training and the music intervention. No other statistically significant effects were found.

As part of the pilot study, six correlations were undertaken using the end scores of reading samples of reading comprehension and the five salient items of the 'Analysis of Reading Fluency'. Statistically significant correlation coefficients were found for covariance between reading comprehension (Neale, 1989) and four salient items from the 'Analysis of Reading Fluency'. No statistically significant effects were found for covariance between reading comprehension and 'presence of a monotone' end scores.

Three highly statistically significant moderate positive correlations between reading comprehension and 'Analysis of Reading Fluency' end scores for the whole sample that had participated in up to 10 weeks of phonological awareness training and the music intervention were found. High statistically significant effects were reported for two strong and one moderate positive correlations between reading comprehension and 'Analysis of Reading Fluency' mean end scores for all participants that received the music intervention and 5-7 weeks of phonological awareness training.

The findings of the analyses showed that within the 'Analysis of Reading Fluency', statistically significant effects were found between 'presence of a regular rhythmic foot' and all the other salient items in the analyses. 'Appropriate use of stress and pause' was found to co-vary most consistently across Groups with 'presence of a regular rhythmic foot'. Statistically significant effects were found for moderate positive correlation coefficients for the sample overall. Other salient items were found to co-vary with 'presence of a regular rhythmic foot' by strong or moderate correlation coefficients with statistically significant effects for Groups representing the overall sample.

The strong and moderate correlations between the 'presence of a regular rhythmic foot' and each salient item suggest that the 'presence of a regular rhythmic foot' may be indeed as Halliday's theory proposes, (Halliday, 1985) the rhythmic unit for sentences written or spoken in English. The strong and moderate correlations between the 'presence of a regular rhythmic foot' and each salient item suggest that the 'presence of a regular rhythmic foot' may be indeed as Halliday's theory proposes, (Halliday, 1985) the rhythmic unit for sentences written or spoken in English.